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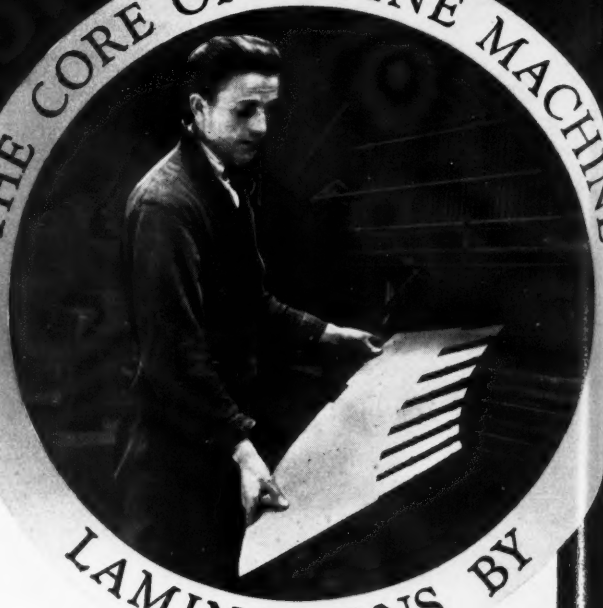

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27 APRIL 1956

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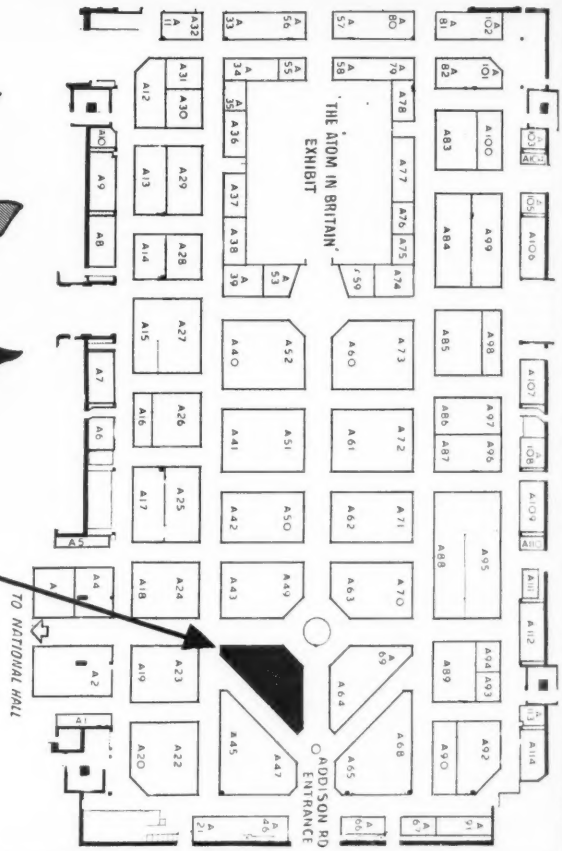

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ELECTRICAL REVIEW

27 April 1956 Vol. 158 No. 17 Established 1872

Shall Progress Continue?

As will be gauged from the review of the annual report of the British Electrical & Allied Manufacturers' Association published in our last issue the electrical manufacturing industry continues in a healthy state although, for reasons now sufficiently well known, the domestic appliance manufacturers experienced some difficulties.

In the home market there was in 1955 again a substantial increase in the amount of generating plant installed. The Central Electricity Authority commissioned 1,818 MW of steam-driven plant and 21 MW of diesel-electric plant; the steam plant exceeded the 1954 total by 268 MW. It is feared by the B.E.A.M.A. Council that the cut in the C.E.A.'s capital investment for 1956-57 of £9 million will fall in the main on generation.

The manufacturers are adapting their works to the production of very large sets —up to 200 MW—and as the demand for these is at present practically confined to the C.E.A. there is some apprehension about the Herbert Committee's suggestion that the C.E.A. should invite tenders from abroad for generating plant. It is not that the British electrical manufacturers are afraid of fair competition; their fear is that foreign offers would not be fair but would either be subsidised or deliberately cut to gain entry into the British market. (We dealt with this subject in our leading article of 17th February last.) It is unthinkable that any Government would allow the electrical manufacturing industry to be disrupted by such action, especially when regard is paid to the possible effects upon our trade balance.

Electrical equipment now constitutes a very substantial proportion of the country's export trade. The B.E.A.M.A. report puts the value in 1955 at £245 million, £26 million more than in 1954. Exports of United Kingdom manufactured goods during 1955 totalled £2,388 million so that the electrical component was just over 10 per cent. Exports are estimated to have been 28 per cent of the country's total electrical production. Conditions in overseas markets are becoming more difficult and our chief competitors are securing a growing proportion of the business. It is obvious therefore that encouragement and help is needed, not harmful interference.

The industry has already been harassed by a Monopolies Commission inquiry and now further uncertainty has been engendered by the Restrictive Trade Practices Bill. This Bill is ostensibly designed to protect the public interest but while that aim is admirable the proposed methods are not. Too narrow a definition of public interest seems to have been adopted. Measures that appear to be in the immediate public interest may ultimately have disastrous results. A certain amount of control has to be expected in the modern state but if the electrical industry is to continue to contribute increasingly to Great Britain's well-being it should be interfered with as little as possible.

RETURN JOURNEY?

It was the original purpose of the B.I.F. Electrical Exhibitors' Committee to look after the welfare of exhibitors at Castle Bromwich: it dealt with such matters as catering arrangements, the handling of exhibits, train services, and so on. In latter years the Committee has endeavoured to hold the electrical exhibitors together and has consequently become involved in matters of policy. It concurred in the proposal to move the Electrical Section from Birmingham to London and is therefore justified in expressing surprise at the timing of the Government's announcement of the closing of the London Section.

Now it is concerned with the future of the electrical exhibits and is asking for the views of this year's exhibitors in London and Birmingham. The main purpose is to ascertain whether those who moved from Birmingham to London are prepared to return next year. As we indicated in last week's leading article, the Government's action has (for the electrical industry at least) necessitated the " re-thinking " of the whole business and it has to be done now.

MECHANICAL OR NATURAL DRAUGHT

When reading Mr. H. Chilton's article in this issue on " Cooling Tower Design " we think it will surprise many of our readers to learn that the main case for the mechanical draught cooling tower does not rest on any difficulty in designing a natural draught tower for a given duty, but rather on making the draught available, i.e., providing a sufficient quantity of air which can pass through the tower in a required time. As the author says, the available draught is undesirably low, seldom exceeding 0·3in w.g., even under very favourable conditions, with the result that the air speed through a packing is lower than in a mechanical draught tower, so a larger packed cross section is needed to provide the required total air circulation.

Although the problem is in this case one of heat transfer via a gaseous medium, it can be likened to the forced draught of a large modern boiler of the type used in power stations for steam generation. There is no insurmountable difficulty in designing a chimney and flue draught system to provide the necessary draught, but the provision of sufficient air for combustion purposes is quite another matter.

TURBINE VIBRATION

The penny standing on its edge on the bedplate of the operating turbo-alternator set has for long been the indication of absence of vibration. But this simple device can no longer be relied upon (if it ever really could be) to give warning of troubles which will eventually lead to excessive vibration.

In many cases the highly-developed sensitivity to vibration of long experienced drivers is still relied upon—and with very good reason—but as Messrs. A. H. Gray and J. S. Hall point out in their article on " Turbovisory Gear " in this issue, to-day with larger sets and higher steam conditions human reactions must be supplemented by some form of instrumentation. Perhaps the best indication of how desirable or necessary this is, is the authors' statement that " It is not always realised that any disturbance which removes the centre of mass (turbine rotor) 0·004in away from the axis of rotation will produce a centrifugal force which will equal the weight (many tons) of the rotor."

HIRE-PURCHASE STATISTICS

At the best the Board of Trade figures relating to hire-purchase business published for the first time cannot do more than give an idea of the general trend; it is impossible to sort out any particular class of goods from the general statistics presented. For instance, index numbers are given for radio and electrical goods shops but there is no distinction between radio and electrical goods. Departmental stores are shown separately but what their hire-purchase business consists of is not shown. Then statistics for the nationalised gas and electricity undertakings are included in the total of all business done and co-operative societies do not report figures for hardware separately from radio and electrical goods. Moreover the statistics go back only to last October and so annual comparison is not yet possible.

With these qualifications in mind it may be said that the index numbers (December, 1955=100) for the value of weekly hire-purchase sales are as follows:—Radio and electrical goods shops: October, 134; November, 105; December, 100; January, 62; February, 64. The actual weekly figure of hire-purchase sales by hardware, radio and electrical goods shops in December is estimated at £1½ million. The violent turn-of-the-year decline is believed to be due more to normal seasonal influences than the effect of the purchase tax increases in October; the latest hire-purchase restrictions dated from 18th February. The total outstanding hire-purchase debt owing to retailers covered by the Board of Trade inquiry at the end of last year is put at £250-£300 million and to the finance houses reporting £160 million. These figures do not change much from month to month.

HEATING APPLIANCE TESTS

Under the Heating Appliances (Fireguards) Act, 1952, local authorities have powers to test domestic heating appliances at retailers' premises for compliance with the regulations. The Low Committee of the Association of Municipal Corporations has drawn attention to a number of difficulties involved in this and suggests the amendment of the law to enable the authorities to conduct tests on manufacturers' and wholesalers' premises and also to provide for an appliance to bear the manufacturer's name and an indication that it has been tested by a local authority.

This presumably means that any appliance tested by any local authority would be assumed by all authorities to conform to the regulations. While the existing system is certainly unsatisfactory it is doubtful whether the proposed arrangement would be much better. What sort of co-ordination would there be to prevent any appliance being tested by a number of authorities? Surely the best way of achieving the objects of the Act is to have all appliances tested by a central independent body—in the case of electric heaters by the E.D.A. Testing House.

Cooling Tower Design

Mechanical Draught versus Natural Draught

By H. CHILTON, B.Sc., A.M.I.Chem.E.

A WATER cooling tower is an exchange device for transferring waste heat from water to air. Warm water is distributed over the cross-section of a tower and it falls some 20 to 30ft into a pond, giving up heat to air passing generally upwards through the tower. The cooling process occurs through the water-air interface and so the surface of water is extended by " packing " over which the water flows. The packing takes the form of hurdles, usually of timber construction, often designed to encourage splashing which further extends the water surface.

Natural and mechanical draught towers differ only in the means used to induce air circulation. In the mechanical draught tower, power driven fans either force or induce air circulation. A typical induced draught tower is shown in Fig. 1. In a natural draught tower the packing only occupies the lower portion of the shell and by far the greater part of the structure serves as a chimney; Fig. 2 indicates the general arrangement. Air circulation is induced by the slightly lower density of the warmed and humidified air inside the chimney.

The volume of air which must be circulated through a large cooling installation is enormous. About one pound of air (say 14 cu ft) is required per pound of water cooled. In a power station the air circulation through the cooling towers is roughly 20 times the air consumed by the furnaces and will aggregate several tens of millions of cubic feet per minute in a large station.

When mechanical draught is used, the pressure drop in the tower must be kept low (not more than about 0·5in w.g.) to avoid intolerably high air circulation costs. The combination of high volume flow rate and low pressure drop is not well suited to the capabilities of fans, and the designer is forced to use large, slow running axial flow fans, which, with their electrical and mechanical gear are expensive in relation to the work they do.

The large air circulation presents no difficulty in designing a natural draught tower but the available draught is undesirably low, seldom exceeding 0·3in w.g. even under very favourable conditions. As a result, the air speed through the packing is lower than in a mechanical draught tower, so a larger packed cross-section is needed to provide the required total air circulation.

This larger cross-sectional area and the high chimney usually result in the natural draught tower costing more than a mechanical draught tower of the same capability. On the other hand, the mechanical draught tower has additional running costs in the form of the power that is required for air circulation.

In a particular case gross annual charges, including power costs and a suitable percentage of the capital cost, may be computed for both designs to form the basis of a realistic comparison. It can easily be shown that the annual cost of air circulation in a well designed mechanical draught tower should be half the annual capital charge and it follows that a mechanical draught tower is unlikely to be economically attractive if its capital cost is more than two-thirds of that of a natural draught tower of the same capability.

It will be apparent that neither mechanical nor natural draught is ideally suited to the requirements of air circulation in all cooling towers; each has the advantage when particular conditions are in its favour. In the subsequent sections of this article, consideration will be given to the circumstances which favour the selection of a particular type of tower.

The disadvantage of a mechanical draught tower is the cost of providing power to operate the fans. Factors which reduce running cost, such as low load factor or cheap electric power, are in its favour.

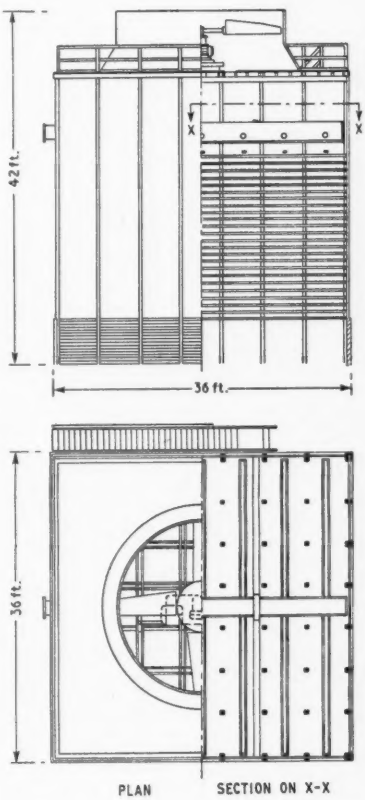
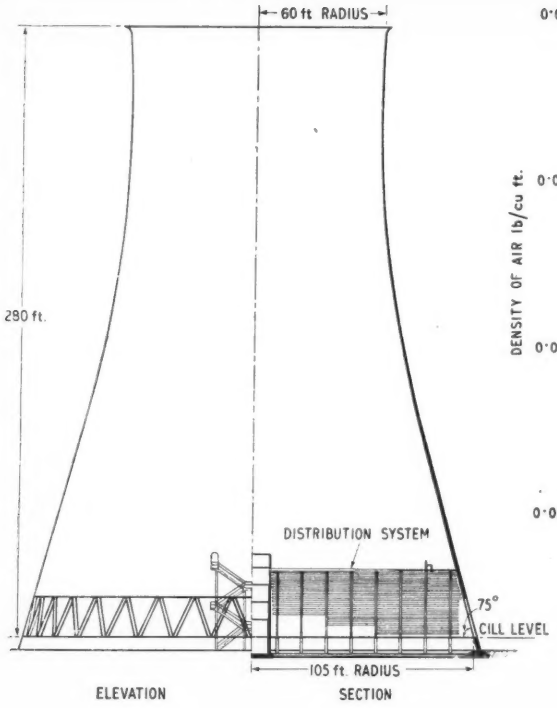


Fig. 1.—Typical single-cell induced draught cooling tower (courtesy Cooling Towers, Ltd.)

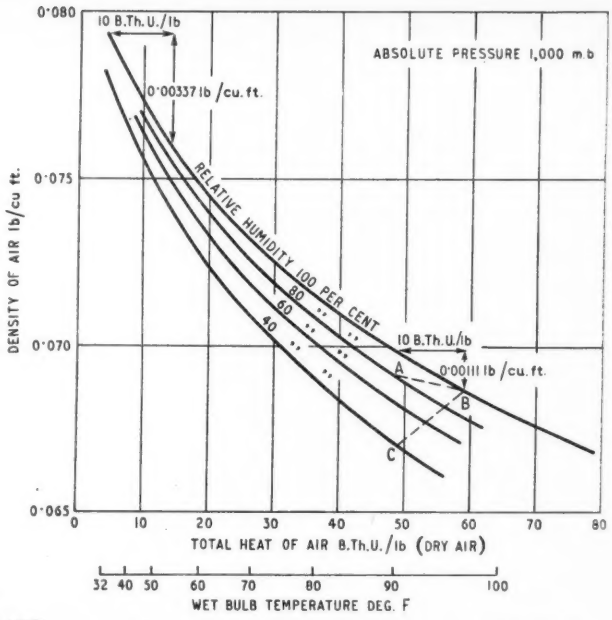
The annual capital charge is a vital factor in cooling tower economics. Briefly, it is usual to debit cooling towers with an annual charge to cover such capital items as depreciation and obsolescence. In this context, obsolescence refers primarily to the possibility of the plant served by the cooling tower becoming obsolete.

Public utilities may compute the annual capital charge so that the initial cost plus accrued interest will be recouped in the estimated life of the tower. The resulting annual charge is in the region of 8 per cent of the initial price, which is very favourable to the natural draught tower. On the other hand, the mechanical draught tower is more likely to be favoured in industries where the annual capital charge is of the order of 25 per cent.

One of the most important factors in the selection of a suitable type of tower is the size of the complete installation. It is quite easy to prepare satisfactory designs for mechanical draught towers when the water circulating rate is as low as 2,000 gal/hr. As the size increases structural costs increase more slowly than capacity and so designs become more economical. Eventually the size of the fan required for a single cell becomes unwieldy and it is



Left: Fig. 2.—*Typical reinforced concrete natural draught cooling tower (courtesy Cooling Towers, Ltd.)*



Above: Fig. 3.—*Variation of density of air with total heat*

cheaper to meet larger capacities by duplicating cells. The tower shown in Fig. 1 is typical of the maximum size of cell in common use. It would be capable of cooling between 100,000 and 200,000 gal/hr, depending on the difficulty of the cooling duty. Several adjoining cells would be used for larger water circulation rates but the economies resulting from this form of construction are quite small.

The only factor limiting the size of reinforced concrete natural draught cooling towers is the difficulty of providing an adequate area for incoming air at the base of the tower without raising the top of the packing so high above pond level that pumping costs become prohibitive. The tower shown in Fig. 2 is a convenient and economical size and it would normally be used to cool between 2·5 and 5·0 million gal/hr depending on the difficulty of the cooling duty.

The natural draught tower must of necessity be fairly high and structural costs become larger in relation to capacity when the size of unit is reduced. Fairly economical designs can be prepared when the circulating rate is about 1 million gal/hr but the reinforced concrete natural draught tower is at a disadvantage when smaller capacities are required.

At this stage, brief mention may be made of the wooden natural draught tower which has an optimum capacity in the range 200,000 to 400,000 gal/hr. Since the last war the cost of timber has risen more than that of reinforced concrete. As a result, the wooden natural draught tower has been almost superseded. It may find occasional application when the circulating rate is suitable and the cooling duty is exceptionally favourable to a natural draught tower.

Cooling Duty

Reference has already been made to the difficulty of providing adequate draught to induce air circulation in a natural draught tower. The draught is proportional to the product of chimney height and the difference in density between atmospheric air and the slightly warmed air inside the tower chimney. The greater this density difference, the more attractive a natural draught tower becomes.

In most cooling tower applications, the rate of heat transfer in the packing is proportional to the difference between the total heat of saturated air at the average water temperature and the mean total heat of the air passing through the packing. The term " condition " will be used (somewhat loosely) to represent these special concepts of total heat. This is not quite the same as a mean temperature difference. The abscissa scale in Fig. 3 is total heat of air, with a subsidiary scale of wet bulb temperature. It will be seen that the change in total heat corresponding to a change of, say, 10 deg F in wet-bulb temperature is much greater at high than at low temperatures. For this reason, the level of water temperatures in a given cooling tower is always lower relative to the atmospheric wet bulb temperature under hot conditions as shown in Fig. 4.

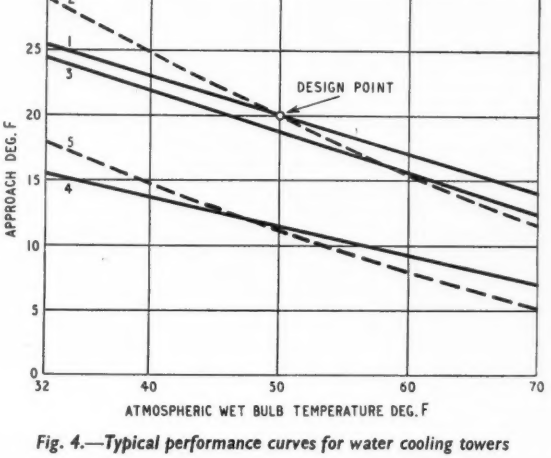


Fig. 4.—*Typical performance curves for water cooling towers*

To achieve a useful reduction in density as the air passes through the packing, the first requirement is that the total heat of the air should be increased as much as possible. It follows from the previous paragraph that this requires the mean water condition to be high compared with the condition of the atmospheric air. The requirement is satisfied when either the approach (outlet water temperature minus wet bulb temperature) or the cooling range (water inlet minus water outlet temperature), or best of all, both are high. If, however, the approach is small in relation to the cooling range, heat transfer rate ceases to be proportional to the simple difference of mean total heat and the cooling duty may be unsuitable for natural draught towers despite a satisfactory high mean water condition in relation to the atmospheric air.

The reduction in air density depends not only on the heat added, but also on the initial air temperature and its relative humidity. Fig. 3 shows a graph of air density against total heat for various relative humidities. If saturated air at 32 deg F is heated by, say, 10 B.Th.U./lb its density is reduced by 0·00337 lb/cu ft while the same amount of heat added to saturated air at 90 deg F reduces its density by only 0·00111 lb/cu ft.

If the relative humidity of the atmospheric air is low, its density at constant total heat is reduced. There is no corresponding reduction in the density of the warmed air because it is humidified in its passage through the packing. Thus the change of density is smaller as shown by the line AB. If the atmospheric temperature is high and the relative humidity is low, the air may actually increase in density as it is warmed and humidified in the tower, as shown by the line CB in Fig. 3. In such cases, a natural draught tower may be incapable of achieving the desired cooling duty.

Since the air circulation in a mechanical draught cooling tower is independent of the cooling duty, it finds its most favourable applications when its competitor is at a disadvantage, namely, when the atmospheric condition is hot and dry, and the required mean water condition is little higher than the atmospheric condition.

Fig. 4 attempts to illustrate these points with actual performance curves, prepared for towers both capable of cooling the same amount of water through 18 deg F to 70 deg F when the atmospheric wet bulb temperature is 50 deg F and the relative humidity is 70 per cent. The full curve 1 and the dotted curve 2 represent natural and mechanical draught towers respectively at full circulation rate and they show the substantial advantage of natural draught at low temperature and of mechanical draught at high temperature.

If the relative humidity were 100 per cent, the performance of the natural draught tower would be improved considerably as shown by curve 3 but the performance of the mechanical draught tower would be unchanged.

At half water rate the towers would be capable of more difficult cooling duties as shown by curves 4 and 5. As would be expected, the performance of the natural draught tower improves rather less than that of the mechanical draught tower. These half load curves can be regarded as indicating the improvement in performance which may be obtained by doubling the cost of the towers.

Mechanical draught towers have two inherent disadvantages. First, the mechanical gear, particularly gearboxes and fans, may give trouble. Second, the hot moist air from the towers may be drawn down to ground level.

It is generally admitted that widespread trouble has been experienced with gearboxes and fans which have been criticized on the grounds of both reliability and efficiency. The manufacturers of this equipment have revised their designs and claims have been made that these difficulties have been overcome. At least one large user of mechanical draught towers has adopted special low speed vertical shaft motors, direct coupled to the fans, with satisfactory results.

The warm, moist air is discharged from a mechanical draught tower at a level of about 40ft above ground level. Experience has shown that it is often drawn down to ground level by the eddy at the lee side of the tower. There is a very serious danger of this warmed air being recirculated through the tower with disastrous effect on its cooling performance. This trouble does not seem to be important in small installations, but when the water circulation rate becomes millions of gallons per hour, recirculation of heated air becomes a major issue.

The probable extent of recirculation depends on such variables as cell arrangement, site topography and wind strength and direction. At present it cannot be accurately predicted, so some cooling tower designers are reluctant to give firm guarantees in a form such that they carry full responsibility for recirculation.

The warm, moist air discharged may interfere with the ventilation system of adjacent buildings and cause general dampness in the vicinity of the towers. In cold, damp weather the discharge takes the form of a thick, persistent, white plume. If it descends to ground level a local fog results which is always objectionable and may be dangerous if it encroaches on a public highway.

Reinforced concrete natural draught towers are high enough for the plume to disperse well above ground level. They are not subject to recirculation nor do they cause fog nuisance, but because of their height and size, objections on æsthetic grounds are sometimes raised.

One further factor may be of importance; mechanical draught towers, particularly those of prefabricated timber construction, are easily erected by local labour in any part of the world. Both the design and construction of reinforced concrete natural draught towers are specialized undertakings and a contractor without experience in this particular field may not offer an attractive tender.

Conclusions

The circumstances favouring natural draught may be summarised as follows:—

(1) Large size of installation (more than 1 million gal/hr).

(2) Cold atmospheric conditions (less than 55 deg F wet bulb temperature).

(3) Applications in which it is important to consider total costs of cooling spread over a long period (say more than 10 years).

(4) High load factor.

(5) Cooling duties in which the mean water condition is high compared with the atmospheric condition.

Central power stations in Great Britain, which depend mainly or entirely on water cooling towers, are an ideal application. The water circulation rate is always several millions of gallons per hour. Loading is greatest in winter when the natural draught tower is at its best and very low circulating water temperatures are unnecessary, because the design of low pressure turbines imposes limits on the vacuum which can be efficiently exploited, particularly in the larger sets currently planned.

The circumstances favouring mechanical draught are:—

(1) Small installation size.

(2) Hot, dry atmospheric conditions.

(3) Applications in which it is essential to cool the water as effectively as possible.

(4) Applications in which economy in first cost is more important than the total cost over a long period.

(5) Low load factor.

Circumstances (1), (2) and (3) are each over-ruling. If

an installation is small, or if it is to be operated in hot desert conditions, or if the best practicable cooling, regardless of cost, is necessary, mechanical draught would be the automatic choice. Mechanical draught towers are well suited to the needs of the chemical industry in this country despite the high load factor and moderately large circulation rate which are often required. This is because the economics of many chemical processes puts a large premium on low circulating water temperatures. Particularly favourable applications arise when there is an overriding requirement that the cooled water temperature shall not exceed some specified maximum under worst summer conditions. Sometimes there is a case for mechanical draught towers in power stations in Great Britain, when they are only required to supplement river water cooling for a few hundred hours per year in times of drought.

Finally, it is interesting to examine briefly the position abroad. Reinforced concrete natural draught towers are often used for power stations in India, where atmospheric conditions are relatively unfavourable. They are never used in America. In India, the attractions of reliability and a form of construction which requires very little imported material may outweigh marginal economic considerations.

Various explanations have been advanced for American practice. Atmospheric conditions, particularly in summer, are generally hotter and often drier than in England. There tends to be less difference between summer and winter load factor. Taxation of industrial undertakings takes a form which puts low capital cost at a premium. There is a well established industry supplying mechanical draught towers and no experience in the design or construction of reinforced concrete natural draught towers. It is easy to see that the combined influence of these factors may rob the natural draught tower of the decisive advantage which it has in Great Britain for central power station applications.

NUCLEAR METALLURGY

Problems Requiring Further Investigation

THREE papers on metallurgical research and development for nuclear reactors were discussed at a meeting of the Institute of Metals on 11th April, the papers having been published in the March issue of the *Journal* of the Institute. The first of these, by Mr. H. K. Hardy, research manager of the Industrial Group, U.K.A.E.A., concentrated on the interdependence of metallurgical research and development of fuel elements, and the design and construction of nuclear reactors. After discussing the processes in the common types of reactor, fuel elements were described. They could be classified into three types: those in which bars or slabs of the fuel provided the strength, in a weak can; those with a strong canning material which supported the bars or slabs of the fuel; and those in which the fuel was present as small discrete particles distributed throughout a non-fissile matrix. Fuel elements had to be dimensionally stable at elevated and fluctuating temperatures but absolute stability of the fuel itself under irradiation might eventually be less important than the ability to predict in detail the changes that would occur in operation. This situation had not yet been reached.

Mr. Hardy explained how the decision to undertake the construction of a reactor involved a careful dovetailed plan such that suitable metallurgical research was undertaken parallel with all construction work in order that suitable production fuel elements and their cans might be available when required. Routine examination of all materials was required and at each stage in the fabrication of fuel elements; powdered metals had to be checked for their gas contents and canning materials for inclusions.

The cost of electricity generated from nuclear energy would depend largely upon securing a reasonable life from the fuel elements and research and developments had to aim at higher operating temperatures, increased life under irradiation, complete reliability, and ease of fabrication.

The second paper was by Mr. J. G. Ball, of the Metallurgy Division at Harwell. He gave a broad review of current and future problems but the special techniques demanded by the toxicity of materials such as plutonium and beryllium were not discussed because although they reduced the rate of laboratory work they did not significantly affect the metallurgical science of the investigations.

Recent developments, he said, had enlarged the field of work to the point where success or failure of a reactor project depended upon the satisfactory solution of metallurgical problems and for power production the nuclear fuel had to be able to withstand much higher neutron doses than in the earlier plutonium producing piles. Unalloyed uranium was unlikely to prove satisfactory for such reactors.

From a review of reactor types he summarised the metallurgical problems into the headings of: irradiation stability of the fuel element; thermal stability of the fuel element; sheathing materials; corrosion; and fabrication. The unique service conditions and the unusual materials which these necessitated were the chief distinguishing features between this branch of metallurgy and any other. One of the principal problems to be solved in fuel construction was the restraint of swelling of the fuel element during service. A number of possible ways of restraining the fuel were being pursued and gave promise. There were firm indications that ceramics would behave better under irradiation than metals but development of their use was likely to depend upon the availability of fissile material because of their lower effective fissile density. In the future there would be more emphasis on the mechanical strength of the sheathing and constructional materials and this trend would be emphasised if ceramic fuels were used.

The ideal sheathing material from a nuclear point of view was beryllium but metallurgically it presented unique difficulties, having a very low ductility at room temperatures. Alloying had not been successful so far in improving this ductility. The metal, however, was by no means fragile at low temperatures and the major problems associated with it would probably lie in its production on a large scale and its economical fabrication.

The last of the three papers dealt with the selection of canning materials for reactors cooled by sodium/potassium and carbon-dioxide and was by Messrs. A. B. McIntosh and Q. C. Bagley, both of the Atomic Energy Authority Industrial Group. This discussed the factors affecting the selection of canning materials where these coolants were

used and gave an account of the theoretical considerations applied to guide such choice, and the experimental investigations carried out to confirm them. The paper went into considerable detail.

Liquid metal cooling was preferred in any reactor for which the core was designed to be relatively small and the heat rating of the fuel high. Of all the elements examined tungsten was the one most nearly inert to uranium and future developments of fast reactors designed to increase the temperature of the fuel/can interface or to use liquid alloys might depend upon the preparation of pure tungsten in a form capable of fabrication.

For use with carbon-dioxide coolant beryllium appeared at all temperatures to be the most suitable container material. Magnesium and its alloys exhibited a number of unattractive features of relatively minor importance and aluminium was incompatible with uranium at low temperatures. The use of niobium and molybdenum were to be justified in use only at high temperatures.

In conclusion, the authors felt that with the availability of plutonium arising from the first gas-cooled reactors being built under the United Kingdom programme for nuclear power the position would need to be reassessed. Metals rejected on account of their neutron absorption at present might then become acceptable. Also the outlook might alter with the introduction of refractory fuels, for the use of a can as now known might be obviated. So frequently did a material judged to be excellent on the basis of corrosion resistance, etc., present almost insuperable problems of fabrication and joining that investigations into these questions should be accorded the highest priority at an early stage.

DISCUSSION

Dr. Ivor Jenkins (vice-president of the Institute of Metals), the rapporteur, referred to the stimulation of interest and activity as a result of the Government White Paper in 1955 describing the programme for the development and utilisation of nuclear power to meet the increasing demands for electricity. The major metallurgical problems were associated with the fuel and its sheathing, but problems associated with the fabrication of reactor shells, the specific requirements of control rods and the various safety devices were in themselves formidable.

Dr. Jenkins then reviewed the papers, dealing with the metallurgical problems associated with the fuel element under the headings of irradiation stability, thermal stability, sheathing materials, corrosion and fabrication. He emphasised that a number of aspects clearly required further investigation and discussion. Dominating the whole scene was the need to work to a somewhat rigid timetable if the national programme for reactor development was to be successfully implemented. The authors had presented the Institute with three papers of the highest quality.

Mr. E. W. Colbeck (metallurgical and research director, Hadfields, Ltd.) traced the history of the British metallurgical effort in the field of atomic energy. He said that it was very pleasing that as a result of the rapid change last year with regard to security conditions it was possible to indicate the very considerable effort that British metallurgists had made in the field of atomic energy.

Dr. L. Wyatt (U.K.A.E.A., Risley) dealt with the feasibility study for the Calder Hall reactors and said that in two years so much progress had been made that a small reactor had been designed to be built at Harwell. So much was thought of the reactor that it was greatly enlarged in size on the design study and had formed the basis of the industrial reactors now being projected.

Dr. W. E. Dennis (chief metallurgist, G.E.C.-Simon-Carves Industrial Atomic Energy Corporation) said that the detailed account of the method evolved by the A.E.A. for proceeding from research to reality would be particularly welcomed by the industrial groups which had recently entered the field. More than ten comparatively large metallurgical laboratories were now engaged almost exclusively on work for the nuclear power programme. As the total annual supply of graduate metallurgists for the whole of British industry remained at little more than 100, co-ordination and collaboration to ensure the proper application of the available effort was of primary importance.

Mr. G. W. Horsley (senior scientific officer, Metallurgy Division, A.E.R.E., Harwell) dealt with methods of controlling or minimising oxygen concentration in a liquid sodium coolant circuit in view of the excessive corrosion often caused by oxygen contaminated sodium.

Dr. C. Edeleanu (Brown-Firth) said that further information about impurities would be helpful, most commercial materials having various elements, such as cobalt, not added on purpose.

Dr. B. R. T. Frost (senior scientific officer, Metallurgy Division, A.E.R.E., Harwell) dealt with problems relating to the use of liquid metal fuel reactors, and said that in that field the metallurgist had a chance to forge ahead and tell the engineer what to do.

Mr. A. B. McIntosh (head of Culcheth Laboratories, U.K.A.E.A. Industrial Group) said that when the engineers came on the scene the question became one of achieving a target within a particular time. On the production side it was then found that the gaps in normal metallurgical knowledge were so great that there was no effort available to study the particularly difficult problems which assailed the technology of uranium. There had been questions relating to aluminium, stainless steel and many other quite normal engineering materials which were at that time being called upon to conform to specifications hitherto not required.

E.P.E.A. Meter Group

THE eighth annual dinner of the Southern Meter Engineers Technical Group of the Electrical Power Engineers Association was held on 20th April. The toast of " Our Guests " was proposed by the chairman, Mr. F. Lumby, who referred especially to the presence of Messrs. L. H. Welch (chief engineer, London Electricity Board), A. M. F. Palmer, M.P. (secretary, E.P.E.A. National Technical Groups), Mr. Charlie Pheby (representative of comedy talent among the membership) and the technical Press. Responding, Mr. Welch suggested that specialised knowledge, such as that possessed by the members, was not always regarded as highly as it should be and was called upon only after decisions had been made by others. Seconding the response, Mr. L. B. Golds said that the group was the only one formed by meter engineers in the country to exchange experience in an atmosphere of good fellowship.

In proposing the health of " The Chairman," Mr. H. S. Petch referred to Mr. Lumby as the founder in 1942 of the group, of which he had been nine times chairman. The number of members was now 230. In his reply Mr. Lumby paid a tribute to the vice-chairman, Mr. Yardley, and the hon. group secretary, Mr. O. G. Davis, for their energetic support. He thanked Sangamo Weston, Ltd., Aron Electricity Meter, Ltd., and Ferranti, Ltd., for kindly providing the entertainments, and Venner, Ltd., who were responsible for the printing connected with the function.

Turbovisory Gear

Electrical Indication of Out-of-Alignment of Steam Turbine Sets

By A. H. GRAY, M.Sc., M.I.E.E., and J. S. HALL, B.Sc.Tech., A.M.I.Mech.E.*

As the capacity of the steam turbine has increased, along with the use of progressively higher steam temperatures and pressures, so have the hazards of operation become greater. Many experienced drivers with five decades of tradition behind them have a highly developed sensitivity to vibration, the most frequent outward sign of incipient trouble. Conditions to-day, however, are such that some form of instrumentation is necessary to supplement the driver's skill.

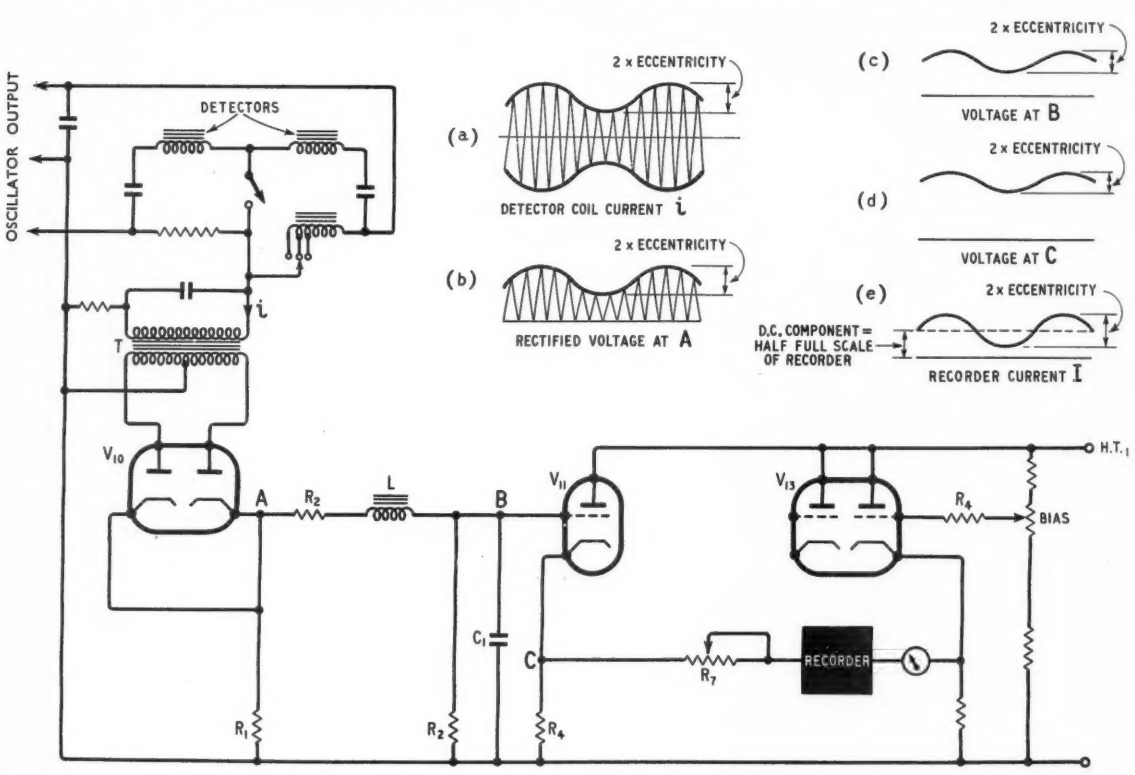
Modern steam conditions necessitate the registration of abnormalities and the application of corrective measures before the sensory perception of vibration is received, if the machine is to be maintained in the best possible condition for economical and reliable operation. Turbine designers recognised the need for accurate instrumentation about 12 years ago and during the subsequent period much experience has been gained on site to substantiate the necessity for these measurements.

The value of this instrumentation is possibly most apparent during the run up to speed, when corrective measures can be applied with little consequential delay, providing information is available immediately any perturbation arises. Modern conditions demand the use of a considerable number of machines operating on an intermittent basis which enhances the value of turbovisory gear. This does not mean that the gear should only be used during the starting sequence, since a continuous history of the machine operation checks the performance of the machine and indicates immediately the development of any unusual condition.

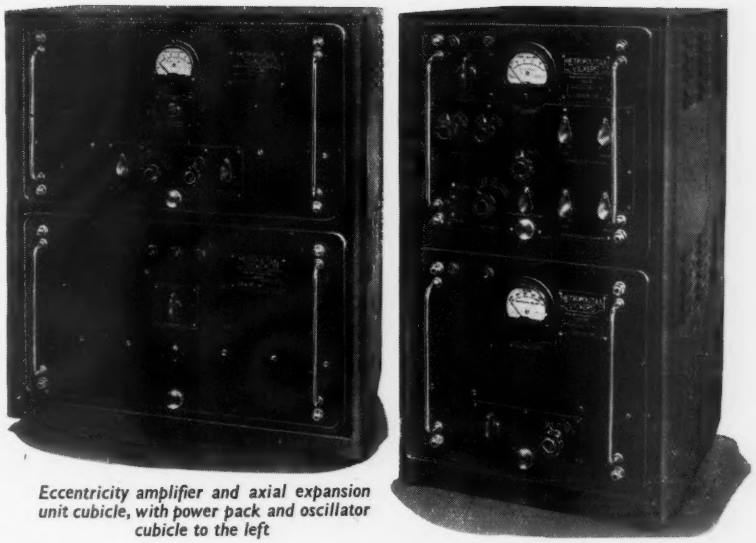
Large steam turbine rotors weigh many tons and rotate at speeds up to 3,000 r.p.m., and although this is well known it is not always realised that any disturbance which removes the centre of mass 0·004in away from the axis of rotation will produce a centrifugal force which will equal the weight of the rotor, thus giving a measure of the care which is required to ensure smooth running. The accurate measurement of the eccentricity of the shaft will obviously therefore become an extremely important feature of any measuring aid given to the driver.

Again, remembering the inevitable differences in mass and conditions of heating of the rotor and the stator, it will be realised that the rates of expansion between these two items may differ considerably during the application of steam, and bearing in mind that the clearances between them are of the order of $\frac{1}{16}$in to $\frac{1}{4}$in, a measurement of the differential expansion between the rotor and the stator also becomes a desirable item of knowledge in this instrumental aid. Initially, these two measurements, eccentricity and differential axial expansion, were considered the only necessary measurements. Subsequent experience, while still regarding them as of paramount importance, has demanded the introduction of further items of knowledge to provide easier starting technique.

* Both authors are with the Metropolitan-Vickers Electrical Co., Ltd.



Bearing in mind the magnitude of the error which is to be detected and corrected in order to ensure smooth running with its concurrent reliability and economy of performance, the necessity of great accuracy is apparent. To obtain such accuracy the measurement should, of course, be made at the actual centre of mass. Unfortunately, this location presents very serious difficulties due to the lack of space and the presence of high temperature, hence a compromise has to be effected and the measurement is usually made in the pedestal itself. The use of the pedestal as a measuring point removes the above difficulties but does introduce complications and makes the interpretation of the results somewhat more difficult owing to possible complex movement of the shaft in the bearing. Fortunately, these complications do not nullify the utility of the gear.



Eccentricity amplifier and axial expansion unit cubicle, with power pack and oscillator cubicle to the left

Initially, this measurement was undertaken by mechanical and optical means but the obvious disadvantages of such gear caused the introduction of the present-day electrical method. This demands the measurement of the impedance of two magnetic circuits each including an air gap formed by the rotor shaft itself and special detector magnets which are rigidly connected to the bedplate of the machine. Any departure from the true axis of the rotation produces a dissimilarity between these impedances, which is amplified and fed into suitable indicating and recording instruments. In practice, this measurement is required for two running conditions. Firstly, the important low speed operation when the steam is first applied and, secondly, normal speed operation when the turbine set is performing its normal task and supplying power to the electrical system. Fig. 1a represents the basic circuit used for low speed operation and Fig. 1b gives the basic circuit used for normal speed conditions. In passing, it is interesting to note that most mechanical and optical methods failed to give a satisfactory measurement under the normal speed conditions.

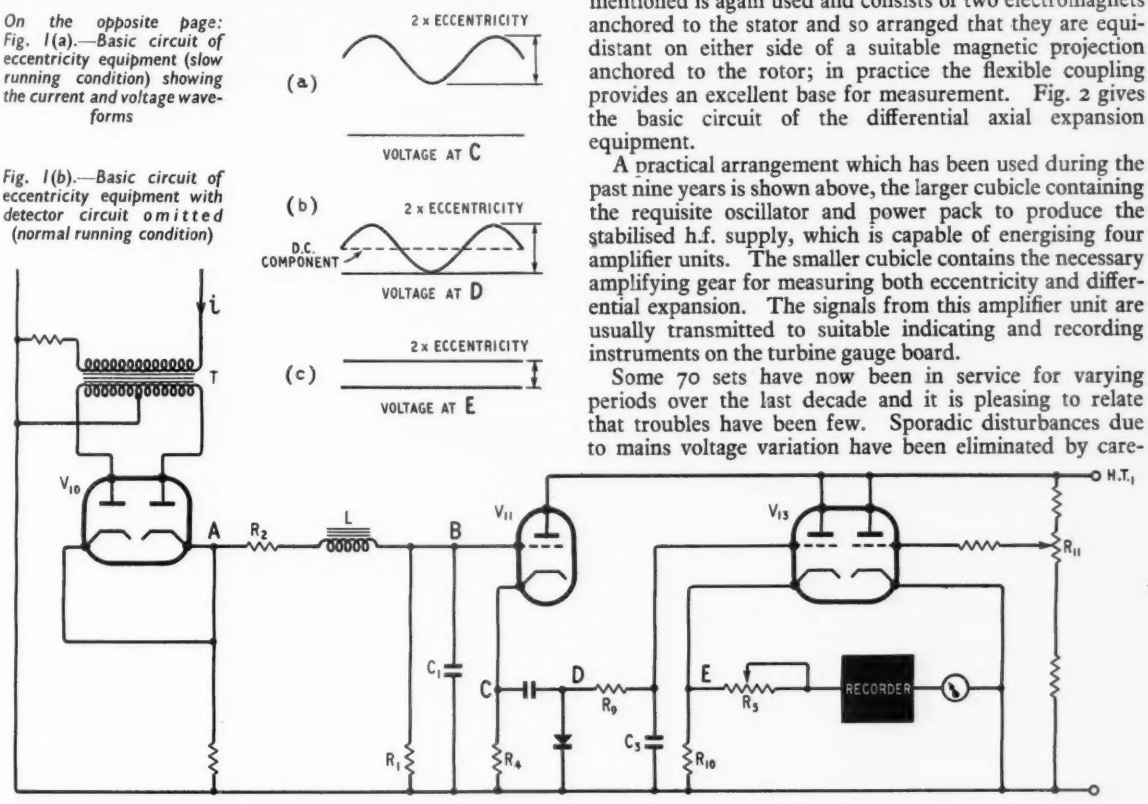
The measurement of differential axial expansion is a simpler problem since the order of distances to be measured is greater and hence the amplifying problems are considerably reduced. The impedance network method already mentioned is again used and consists of two electromagnets anchored to the stator and so arranged that they are equidistant on either side of a suitable magnetic projection anchored to the rotor; in practice the flexible coupling provides an excellent base for measurement. Fig. 2 gives the basic circuit of the differential axial expansion equipment.

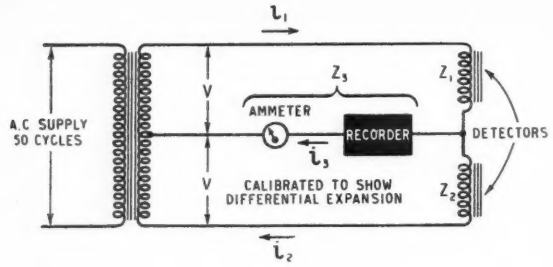
A practical arrangement which has been used during the past nine years is shown above, the larger cubicle containing the requisite oscillator and power pack to produce the stabilised h.f. supply, which is capable of energising four amplifier units. The smaller cubicle contains the necessary amplifying gear for measuring both eccentricity and differential expansion. The signals from this amplifier unit are usually transmitted to suitable indicating and recording instruments on the turbine gauge board.

Some 70 sets have now been in service for varying periods over the last decade and it is pleasing to relate that troubles have been few. Sporadic disturbances due to mains voltage variation have been eliminated by care-

On the opposite page: Fig. 1(a).—Basic circuit of eccentricity equipment (slow running condition) showing the current and voltage waveforms

Fig. 1(b).—Basic circuit of eccentricity equipment with detector circuit omitted (normal running condition)





$$i_3 = \frac{V(Z_2 - Z_1)}{Z_1Z_2 + Z_3(Z_1 + Z_2)}$$

Fig. 2.—Circuit arrangement of axial differential expansion equipment

fully designed stabiliser circuits. Mechanical and electrical breakdowns of the detector magnets have been overcome by the use of special moulded protective coverings around the detector magnets.

The presence of expendable items in the shape of thermionic valves has, of course, always necessitated periodic replacements. These replacements have now been considerably reduced by the removal of these valves wherever possible. In the latest form of apparatus, the power pack and oscillator have been replaced by a small h.f. inductor generator set and the amplifier circuits redesigned to remove all valves except one.

With regard to the accuracy of the device, this has been proved to be quite adequate for all practical purposes. Whilst the design of the equipment itself is such that it is capable of giving an extremely high degree of accuracy, the difficulty of obtaining absolute measurements of the rotor shaft position in space reduces the overall accuracy to the order of 0·001in.

Numerous occasions have arisen during the operation of these equipments whereby the presence of this information has enabled the turbine drivers to take corrective measures and so prevent damage to the sets before serious vibration had been detected. For example, high temperature gradients across the rotor due to incorrect application of steam during the run-up period are readily detectable in the eccentricity indication. Furthermore, deterioration in mechanical balance or thermal instability of the rotor over long periods of operation can be observed by examination of the recorder charts from time to time. Fig. 3 shows the typical behaviour of the i.p. and h.p. rotors of a 50 MW set during the run-up period and application of load.

Turbovisory gear initially used two measurements: eccentricity and differential axial expansion. It is now usual to add to these readings, speed, kilowatt output of the set and various direct or differential temperatures. When any examinations of turbovisory records is undertaken it has been found essential to have reference to the speed and kilo-

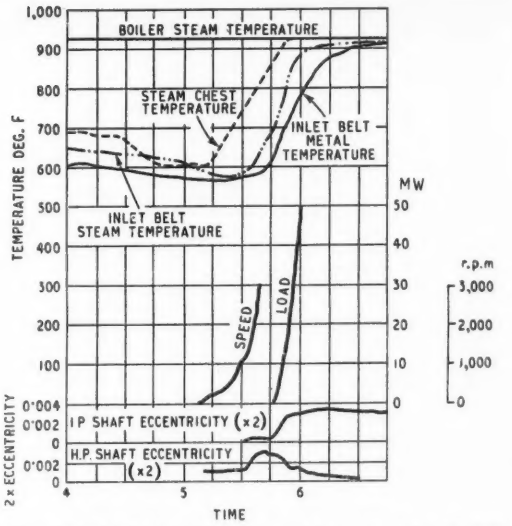
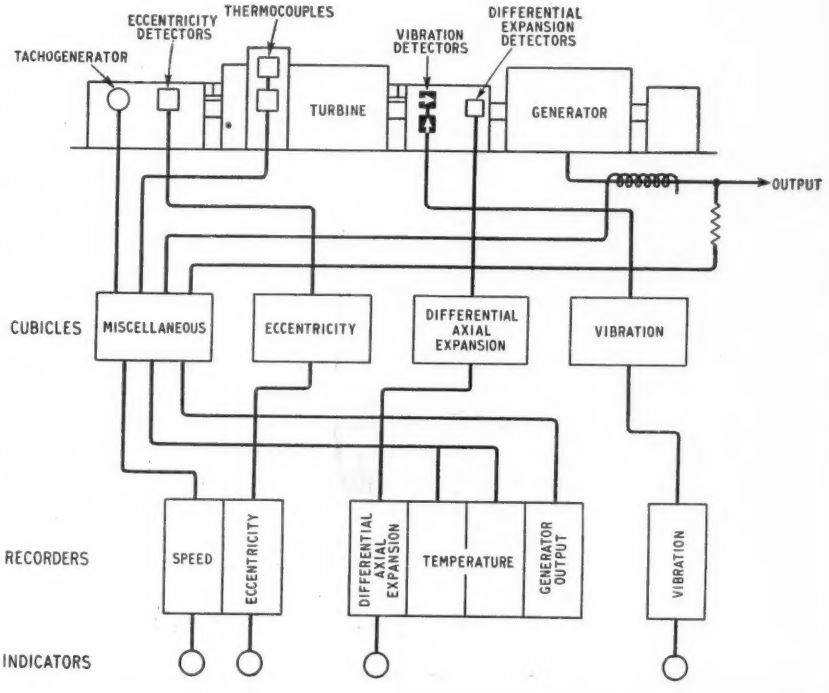


Fig. 3.—Typical behaviour of the i.p. and h.p. rotors of a 50 MW set during run-up

watt output and furthermore, since most distortion troubles are due to incorrect thermal gradients, a measurement of temperatures at carefully selected points is sometimes a clearer guide to avoidance of distortion than was available with the original turbovisory equipments.

Certain schools of thought consider that the measurements of vibration and overall expansion of the turbine also provide useful information concerning the behaviour of the turbine. Whilst this viewpoint is not universally accepted apparatus has been designed and is available commercially to provide these readings where it is considered necessary. Fig. 4 represents schematically a comprehensive turbovisory equipment employing all these forms of measurements.

Fig. 4.—Schematic diagram of complete turbovisory equipment



Digital Computer Techniques

Report of Discussions at Recent Convention

APART from the opening meeting, nine general sessions of the Convention on Digital Computer Techniques were held on 10th, 11th and 12th April. At the first of these, dealing with the engineering and scientific applications of digital computers, Mr. J. M. Hahn mentioned that the Society of British Aircraft Constructors had formed a panel, consisting of representatives of the aircraft industry, Government research establishments and computing organisations, which met regularly to discuss problems suitable for treatment on digital machines. This enabled clear-cut programmes to be drawn up and led to a valuable interchange of ideas between aircraft firms and computing organisations. The example might well be followed, he suggested, by other industries.

Much of the discussion was concerned with the relative merits of digital and analogue computers. Mr. A. Ridlington thought that for accuracy the digital machine had the advantage; for speed they were roughly similar, but for flexibility the analogue method was much to be preferred. Mr. W. D. Worthy suggested that anyone with limited capital would be well advised to buy a small analogue computer and a large general-purpose digital computer. Mr. Humphrey Davies emphasised the need for a much cheaper form of computer to do the very simple analytical problems generally met with in design. The need to ensure that prospective research and design engineers obtained some training in digital computer techniques was also underlined.

Computer Development in France

At the next session, which was concerned with business applications, Mr. P. Dreyfus, of France, described the "Gamma 3" computer and its magnetic drum extension. In France, he said, computer development had taken a different road from that followed in this country, and there were some 450 medium and small size computers in use, mainly in commercial applications. There were now more than 300 of the "Gamma" type in use in ten countries. In France, 20 per cent were used in the four major banks, 15 per cent in insurance companies, 15 per cent for computation in the aircraft and electrical industries, and so on. The price ranged between £20,000 and £50,000.

At an evening session applications of digital computers in industrial control were discussed. Dr. I. J. Faulkner, in introducing the subject, remarked that the push-button factory was a long way off, but much could be done by the use of digital computers to enable managers and foremen to do a better job by giving them reliable information while it was still not merely "warm" but "hot"; to-day it had usually been in cold storage for 24 hours. Most of the contributors emphasised that reliability was essential when computers were used in industry, and Dr. M. V. Wilkes (Cambridge University) suggested that the proper role of the computer was not to control the plant directly but to provide information; it was better to connect it not to the plant, which might blow up, but to the plant manager, who was less likely to do so. Electronic components, it was agreed, were not inherently unreliable, but they were very often complex and not so amenable as mechanical components to preventive maintenance, so that they were subject to catastrophic failure. It might be possible to design machines having a sufficient redundancy of active elements to continue to function even if some of the components failed. Mr. E. A. Newman (N.P.L.) suggested that a machine might be designed which, like the human brain, would be able to go on doing the simpler jobs even if some defect prevented it doing more complicated ones. It was probably only in that way, he thought, that 100 per cent reliability would ever be attained.

The next two sessions, on the Wednesday morning and afternoon, were devoted to the description of commercially available machines. Dr. S. H. Hollingdale (R.A.E.), as an independent user of "Deuce," said that most of the lost time could be attributed to electromechanical and mechanical faults rather than to electronic ones, and a high proportion of all the faults could be regarded as teething troubles. Mr. B. W. Pollard (Ferranti) said that no serious effort was apparently being made in this country to produce at least one really large, fast machine, but Mr. M. Lehman (Ferranti) pointed out that the Imperial College machine had achieved the operating speeds of the American machines. Mr. G. Ashdown (Paris) referred to some large machines which were made in France, to correct any impression that only small machines were made in that country.

Mr. B. D. Bagnall (Esso) pointed out that office machines would be operated by accounting assistants rather than mathematicians, and ease of programming was most important. They had found that the provision of a simple interpretative routine enabled unskilled people to use the machines and to draw up workable programmes. He suggested that the I.E.E. should join with the B.S.I. in drawing up a standard code of practice. Dr. G. A. Eskine drew attention in that connection to an American suggestion for a standard code which, though different from the codes of individual manufacturers, would be available for use in interpretative routines or translating machines.

Experimental Machines

At the session on Wednesday evening experimental machines were discussed and descriptions given of a number of such machines at present in use or under construction. In the discussion, Mr. E. P. G. Wright (Standard Telephones & Cables, Ltd.) emphasised the need for an electronic computer which would work for 24 hours a day, and not for 80-90 per cent of the time only. Such a machine would, he said, have many applications.

The Thursday morning session, which dealt with the transistor, attracted so large an audience that the proceedings had to be relayed to three other rooms. Mr. T. R. Scott, the opening speaker, said that the extensive and intensive development programme of the decade 1948-1958 would have created a major revolution in electronics. There was now a clear case for the manufacture and use of reasonable quantities of a simple transistor. The Bell system in America had had in use some 15,000 point contact transistors for a considerable period, with a record so far of 0·03 per cent failures per 1,000 hours of socket life. For the deaf aid and radio markets in the United States more than two million transistors had been sold.

Mr. E. H. Cooke-Yarborough described a number of ways in which transistors could be applied in digital

computers with advantage in respect of size and power dissipation, and probably reliability. Developments might at present be handicapped by efforts to translate valve circuits in terms of transistors, and he looked forward to seeing great developments by a generation of electronic engineers who had never used a valve.

The Thursday afternoon session was concerned with input and output, including analogue/digital conversion, and the last session with the computer in a non-arithmetical role, Dr. A. D. Booth giving such examples as the playing of simple tunes and the recognition of sounds and referring to the development of machine translation. Dr. A. L. Samuel spoke of making a computer play draughts, and Dr. Kloalmat, on character recognition, said that a logic for the recognition of printed characters employing a proportional parts method had been tested extensively. In the discussion the use of computers for dealing with road traffic problems was referred to.

Numerical Analysis

In addition to the general sessions of the convention, seven specialist sessions were held. At the first of these, which dealt with numerical analysis, Mr. J. H. Wilkinson (N.P.L.) said he was an enthusiast for the iterative method, which economised very much on storage, as it was only necessary to store the matrices. Secondly, having solved it for one value of the parameter it was possible to give a good guess at the vectors for the next one, and the method was extremely accurate both as regards vectors and roots. Dr. J. C. P. Miller (Cambridge Mathematical Laboratory) pleaded for the use of more sophistication. The Aitken process could be used, or one could go a little further and use the last three or four iterations and so improve the speed of convergence. He had always been afraid of floating decimal places because they introduced extra figures which were known to be false, but in the method described by Mr. Brooker random digits were wanted, so that that was one of the cases where a floating decimal machine could be safely used.

The second specialist session was on the subject of logical design. Mr. G. M. E. Williams, referring to the controversy on the relative merits of analogue versus digital computer systems, said the answer was very simple, namely, to use whichever happened to be best for the problem in hand. Already America was faced with the use of computers for controlling processes in industry, and those machines would have to be handled by people who were not mathematicians or even trained to the standard of the average engineer. Mr. C. Strachey suggested that the logical design of machines should be based on a study of previous machines and the use to which they had already been put. It was important that in the logical design of the digital computer regard should be had to experience in digital computers rather than in analogue machines.

Professor D. R. Hartree, opening the discussion at the third session, on numerical analysis, said there were often more ways than one of carrying out a projected calculation, and it was important to know something about the methods to be avoided. Not enough had been written on how not to do numerical calculations. Knowledge of what not to do was more important in planning a machine calculation than in planning a hand calculation, because with a machine it was not as easy to recognise symptoms of trouble. These thoughts, he said, had been stimulated by two inquiries in the course of two weeks from users of automatic digital calculating machines, one in Canada and one in Britain, who were having trouble with a predictor-corrector method for the numerical integration of first-order differential equations. Those inquiries, from such widely separated sources, suggested that a weakness of this method was not widely enough known to serve as a warning to those tempted to use it by its apparent advantages.

Storage Methods

The fourth session was concerned with rapid access storage, including the use of magnetic cores for storage and switching. The opening speaker (Mr. Norman Taylor) described magnetic core storage development at the Massachusetts Institute of Technology. During the discussion it was pointed out that the core manufacturer found the variety of systems a little bewildering. The idea of a single specification for testing a single type of core rather than a multitude was obviously attractive. The cost of cores was considered to be high and it was thought that there was considerable scope for improvement here, although it would depend to some extent on their use on a wide scale. If used on a wide scale, however, they might in some cases, but not all, rival drums. A Japanese speaker said cores were cheap in his country by reason of the system of manufacture which had been developed there.

The opening speaker (Dr. M. V. Wilkes) at the fifth session, on magnetic tape, referred to the special role of magnetic tape as a storage medium for data processing rather than heavy computing. Reference was made during the discussion to the processing of large quantities of experimental or measurement data. Attention was drawn to the need for much faster stop and start times and also to the need for a buffer store between the tape and the main computing equipment. Some preference was expressed for the pneumatic rather than the punch-roll system because of the more rapid acceleration.

During the continuation of the discussion at the sixth session, function transistors and cores for storage purposes were said to work satisfactorily. A system of parallel read wires each of which passed through only a small number of disturbed cores was said to be preferable when using transistors, because of the need for accurate time selection. One speaker said it was possible to construct a complete computer using a combination of transistors and cores; but whereas the logical circuits might be operated at high speeds the store would have to be operated at a somewhat lower speed until transistors with a frequency coefficient of 500 kc/s and a higher permissible dissipation had been produced. It was pointed out that transistors of a regenerative type offered many attractive features, but they would be more satisfactory if more defined.

At the last of the specialist sessions, on techniques and components, a Swedish computing machine with an adding time of 15 Mc/s and a multiplying time of 300 Mc/s, claimed to be the fastest in operation although of conventional design, was described by Mr. Bergmann. The storage time was less than 1 Mc/s. The problem of the use of a large number of valves when electronic switching was used for reading and writing was referred to by Mr. G. R. Brooks. A system for 256 tracks could be designed requiring only 180 valves, allowing 30 or 40 for control purposes. Among other subjects discussed at the session was a means of increasing the efficiency of transducer coil assemblies.

R.F. Coaxial Cables

Publication 78 of the International Electro-technical Commission contains recommendations for rated characteristic impedances and associated diameters for radio-frequency coaxial cables. The diameters given are for cables with a solid polyethylene dielectric; diameters of air-spaced or semi-air-spaced cables are under consideration. The publication is on sale at the Central Office of the I.E.C. at the price of Sw.Fr. 2·0 per copy plus postage.

VIEWS on the NEWS

By REFLECTOR

"PILGRIM THREE" in the February *Electrical Contractor and Retailer* wonders what advice had actually been given to a retailer's customer who said that she had been told not to buy an aluminium kettle because her house was wired with copper. He has discovered, he says, that what was probably said was that her house was piped in copper. Trouble occasionally arises from the action of copper-conveyed water upon aluminium utensils and the use of copper kettles, etc., is recommended. "Pilgrim Three" says that although he has copper piping he also has a water softener which may have countered any ill effects.

* * *

I am sorry to learn that this same "Pilgrim Three" whose amusing and instructive notes have been appearing in the *Electrical Contractor* for the past ten years has decided to relinquish the job of "columnist." The pen-name covers (for the few who do not know) the identity of Mr. P. G. Wallis, for long a leader of the Electrical Contractors' Association and president in 1950-51. The name of the first "Pilgrim" seems to have been lost in the mists of history; "Pilgrim Two" was the well-known Gloucester contractor Mr. R. A. Parsons who contributed the notes for twenty years.

* * *

In the 27th January issue I commented upon the experiences of American meter readers who, like postmen, are subject to the dislike of dogs. Mr. N. R. Johnston, manager (Queensland) of Australian Electrical Industries Pty., Ltd., read the note and brought it to the attention of a friend of his in the Australian Postmaster-General's Department. The latter says that the Australian Post Office had the same trouble but overcame it by requiring all householders to put letter-boxes on their front fences. Before that the postmen used to employ their mailbags somewhat, it seems, in toreador style, "bonneting" the dogs and (*pace* the R.S.P.C.A.) kicking them aside. Alternatively, they kept a half-brick in the bottom of the bag which they employed as a defensive weapon. How Australian meter readers, who normally I suppose are not equipped with mailbags, get on still remains to be explained.

* * *

I have known carron oil as an emollient for the treatment of burns for many years but have only just found out how it got its name. As far back as 1760 Carron Company (the definite article is impermissible) found that its employees were constantly sustaining burns and so it introduced a mixture of linseed oil and lime-water for their relief. The *Carron Cupola* (the company's magazine) from which I have derived this information says that employees who left the company and went abroad carried the formula with them and made the qualities of carron oil known around the world. Nowadays, the prescription is more elaborate; only the lime-water remains from the original make-up (ten parts) and to it are added nine parts of olive oil and one part eucalyptus oil.

* * *

A delegate to the recent National Conference of Labour Women is reported by the *Daily Mail* to have said that domestic electrical appliances were over-rated and were always going wrong; "and then the old man fiddles with them and they never work again." It is true that some women over-rate these appliances by treating them as though they were solid lumps of cast iron; that is where the faults usually lie. Reasonably handled they give very little trouble. When they do go wrong it is often safer not to leave it to the "old man" but hand them over to people who know how to deal with them.

* * *

Criticisms of the North of Scotland Hydro-Electric Board for what were termed its excessive charges were made at the annual Convention of Royal Burghs in Edinburgh. It was even said that the cost of the Board's electricity was higher than that of the coal-produced power in the South of Scotland. As reported in *The Times*, Provost P. M. Cumming (Kingussie)

> "made the point that if coal cost more in the Highlands, where there was more, than at the pithead it was only reasonable to expect that electricity would cost less at the lochhead. This, he alleged, was not the case."

* * *

Looking through the *Electrical Review* of 24th April, 1896, I find that sixty years ago discussions were proceeding on a number of topics and problems that are still with us. One article surveys the prospects of producing electricity directly from heat, a subject which the development of nuclear energy has raised in an intensified form. It describes a number of experiments in the use of thermo-piles but these were considered to be imperfect heat engines. Another note, in somewhat allied vein, deals with the possibility of using the sun's energy for the direct production of power and says:—"It is evident that it will not be long before some means is found of utilising it." The same note refers to the need for "a general method for solving differential equations, so that physical problems may be attacked without the necessity of so much ingenuity as is now requisite." There is a brief article on "Comparative Tests of Smoke Preventing Apparatus" and a gas company chairman is reported as stating that if the "electric light" stepped in and prevented expansion of their business consumers would have to pay more for their gas.

"Are We Played Out?" is the title of a note dealing with "the serious inroads which the competition of Germany and Belgium has been making upon fields which were supposed to be firmly controlled by the English manufacturers."

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Electric Passenger Transport

I READ Mr. Reynolds' article in your issue of 6th April with great interest. The return to electric traction will certainly not be easily achieved but is by no means impossible. In the U.S.A., Cleveland has introduced electric rapid transit on private tracks only a year after the abandonment of street tracks, whilst Chicago is extending its rapid transit system on reserved tracks between dual carriageways of arterial roads. Seattle has similar plans, many years after the abandonment of all electric transport.

The oil buses which replaced trams in the U.S.A. have steadily lost traffic as the use of private cars has increased. The Portland buses have lost two-thirds of their passengers in ten years despite purchase of new vehicles, whilst the electric inter-urban lines serving the same city on private rights of way have retained the majority of their passengers despite their use of second-hand cars. It is found that the private motorist will only travel by public transport if he can thereby avoid traffic congestion. If he must face traffic hold-ups he would rather do so in his own car than in a bus.

Although the first cost of a segregated light railway system is high, there is a large reduction in operating costs owing to the higher speeds and the fact that three men in charge of a two-car set can look after 180 passengers, which would require a crew of six if buses were used.

One large Midlands city has recently sent a delegation to the U.S.A. to view train subways in Philadelphia and rapid transit systems elsewhere, with a view to establishing the same here. Actually, a good example of electric rapid transit for a medium-sized city not requiring anything so heavy as the London Underground is to be seen in Oslo, Norway.

American experience has shown that provision of better roads worsens traffic conditions by attracting more motorists. It would be better for the Government to spend money on subways for rapid transit lines in all large cities than on the provision of more roads.

Earlsfield, S.W.18. F. K. FARRELL, B.A., A.M.I.E.E.

Earth Loop Testing

DR. TAGG raises some interesting points in his letter on this controversial subject in the *Electrical Review* of 13th April, but it is doubtful whether the testing method he advocates will replace the mains operated earth loop testing set which injects a current of some 20 A.

It is a well-established principle that circuits and apparatus are tested under conditions similar to those likely to occur during normal operation, and there seems to be no justification for any departure from this rule in the important matter of earth loop testing. An earth loop test employing a variable frequency and a rectangular wave current having an effective value of only 3 A (or less if the loop resistance is appreciable) can scarcely be said to simulate actual fault conditions. The elimination of the superimposed neutral p.d. achieved thereby is a questionable refinement since actual fault currents flow in the phase conductor which is also shared by other consumers and in consequence also has a superimposed p.d.

With regard to the value of the testing current, a practical example of a 7/·029 earth wire may be instanced where all but one strand had been severed at a clamping screw. A current of 3 A would be insufficient to detect the existence of this or similar defects in the earth continuity path.

Concerning the suggestion that the inductance of the earth loop can be neglected, investigations on steel screwed conduit have shown that the ratio of a.c. impedance to d.c. resistance varies according to the value of current flowing. At current values of 2 to 3 A the ratio may not greatly exceed unity, but at typical fault current values exceeding 20 A the ratio is not less than 3 to 1.

It is fundamentally unsound to measure the resistance of the earth loop employing a comparatively low value reversed direct current, and subsequently expect the impedance to remain at the same value when the earth path carries an alternating fault current of comparatively high value.

Colchester. N. D. CUBITT.

Are Standards Lower?

IN the days of Boulton, Watt and Murdock, the foundations of the British engineering industry were laid and high standards of workmanship were set that are still met to a large extent in production of heavy engineering products.

Do you not think it a great pity that the electrical industry grew to maturity in a later age when less exacting standards were accepted as inevitable? One often sees pumps, gas engines and milling plant that have been giving excellent service since the early years of the century but one looks in vain to find electrical equipment that is giving comparable service.

Handsworth, Birmingham, 21. L. R. TURNER.

E.A.W. Conference

THE theme of the 31st annual conference of the Electrical Association for Women, to be held at Llandudno next week, is "Electricity in North Wales." About 500 members and friends from many of the Association's 160 Branches throughout the country are expected to attend. They will be welcomed on Tuesday by the Dowager Lady Swaythling, O.B.E., president, and on behalf of the town by Councillor John Owen, J.P., chairman, Llandudno Urban District Council. The greetings of the electricity supply industry in North Wales will be given by Mr. D. H. Kendon, M.I.E.E., chairman, Merseyside and North Wales Electricity Board, and by Mr. J. L. Ashworth, A.M.I.E.E., chief generation engineer (operation), North West, Merseyside and North Wales Division of the Central Electricity Authority. Mrs. H. Walsh, chairman, E.A.W. North Western Area Federation, will voice the welcome of all the Association's Branches in that wide area.

"Light for Living" is the subject of a lecture-demonstration to be given by Mr. E. B. Sawyer, manager, E.L.M.A. Lighting Service Bureau. This will form a notable contribution to the E.A.W.'s "Planning for Light" campaign, which has been a pleasurable and profitable study throughout the Branches during the past six months. In the evening there will be an official reception and dance at the Winter Gardens.

At the annual luncheon on Wednesday the speakers will be Miss Beryl Nield, J.P., president, E.A.W. Chester Branch; Mrs. Eirene White, M.P. for East Flint; Brigadier W. H. Wynne Finch, M.C.; and Mr. D. H. Kendon.

Electrical Development

REVIEW OF E.D.A.'s WORK DURING 1955

AS usual the report of the British Electrical Development Association is a record of many and varied propaganda, educational and technical activities. It is said that excellent publicity was obtained throughout the year for the cause of electricity and productivity, stimulated by speeches given by members of the Association's staff. Over 600 Press releases were issued in addition to exclusive articles on many subjects and a good deal of editorial attention was given to exhibitions in which E.D.A. participated.

The Association was again asked by the B.I.F. Electrical Exhibitors' Committee to co-ordinate publicity for the Electrical Section and it also undertook the responsibility for Press publicity at the British Electrical Power Convention. Contact was maintained with the B.B.C. and I.T.A. and it resulted in a number of television and radio "appearances" for electrical appliances.

A new series of advertisements ("Four Foundations of Modern Living") appeared in 64 national newspapers and magazines with a combined circulation of 76·6 million. Restrictions on expenditure caused the suspension of advertising in the national daily and weekly papers in the latter part of the year. "Productivity" advertisements continued regularly in 130 trade and technical journals covering a wide variety of industries. Mention is also made in the report of special advertisements covering agriculture and horticulture, street lighting and architecture and building. Assistance was given to members in the preparation of local publicity schemes.

Film Publicity

Seventeen new publications—general, industrial, agricultural, architectural and on films—were issued during the year. Three cinema advertising films and four general films were completed and the production of several new films was authorised by the Council. The E.D.A. Film Library lent nearly 15,000 copies of films, mainly to educational institutions. The number of copies purchased was brought up to over 3,000. Mention is made of royalties on films received from the United States and France. Substantial additions were made to the photographic services.

Fourteen national exhibitions in which the Association took part are detailed and it is stated that Area Boards were assisted in connection with local exhibitions on 22 occasions. There was a large increase, from 10,283 to 12,209, in the number of inquiries arising from the Association's exhibit at the Building Centre.

Much attention was paid to the subject of rural electrification; activities included exhibits at the Royal Show and other shows, the provision of models for agricultural colleges, etc., farm electrification courses and mobile workshop units.

In the industrial electrification field there were many requests for lectures, films and technical literature. A new film, "Planned for the Purpose" was made; a new booklet "Electro-Heat in Industry" was produced for distribution at the Engineering, Marine and Shipbuilding Exhibition; and a book on "Electric Motors and Controls" was published. The new Industrial Development Committee reviewed the Association's activities in this field and suggested an "E.D.A. Industrial Newsletter," mainly to

Viscount Chandos (left) is serving for a further year as president of E.D.A. Mr. D. Bellamy (centre) and Mr. W. S. Lewis (right) have been elected respectively as chairman and vice-chairman of the Council

encourage members of Board staffs to take more interest in load building; the first was issued in June and the newsletter has since appeared at monthly intervals. The Electro-Heat Sub-Committee adopted a memorandum on industrial electric heating processes for circulation to Electricity Board staffs.

Under the heading "Commercial Development," there are references to contact with housing authorities; the production of further data sheets for architects; the heating of buildings; the third "List of Domestic Appliances" for the guidance of housing authorities; and the work of various committees and sub-committees on electrical appliances, cooking, water heating and laundry equipment, commercial catering, street lighting, trolley-buses and tramways, etc.

During the year 233 appliances passed through the Testing House, including 29 for the Advisory Committee on Electrical Appliances and Accessories, five for the Canadian Standards Approvals Agency and 25 for manufacturers requiring certification of compliance with British or overseas standards to assist export trade. A new departure was the examination of electric blankets in connection with the granting of the "Kite mark" by the British Standards Institution and there were seven special investigations into a number of problems.

Educational activities included the annual E.D.A. conference, the annual E.D.A.-E.A.W. conference, the public speaking competition, the salesmanship course, the lecture service, etc. Contact and collaboration continued with a large number of other organisations.

Appended to the report are notes on the work of the Electric Vehicle Association of Great Britain which participated in conferences and exhibitions during the year and conducted publicity in various journals. This Association now has 28 full members and 13 associate members. Another appendix surveys the activities of the Electrical Association for Women.

Annual Luncheon and Meeting

Sir John Maude, Permanent Secretary, Ministry of Fuel and Power, was the principal speaker at the annual luncheon at the Savoy Hotel, London, on Tuesday last, when Viscount Chandos, the president of the Association, presided over a very distinguished gathering, among those present being the Chancellor of the Exchequer (Mr. Harold Macmillan), the Minister of Supply (Mr. R. Maudling) and the Minister of Health (Mr. R. H. Turton).

In proposing the toast "Electrical Development," Sir John Maude expressed the regret of the Minister of Fuel and Power (Mr. Aubrey Jones) at his inability to be present and he also regretted the absence through illness of Mr. V. W. Dale, the director and secretary of E.D.A. He mentioned the present need for restraint and said that the electricity supply industry had helped by "drawing in its horns" a little. But he quoted Burke's dictum that parsimony was not necessarily economy; true economy might mean going to expense. Rural electrification would not be cut back too far and development would continue.

Lord Chandos, in replying to the toast, said that electricity was now so much a part of our daily life that we hardly noticed it. Since E.D.A. was born in 1919 the number of electricity consumers had grown from 700,000 to 15 million. There was still need for development work for "saturation" was nowhere in sight. Nuclear energy, high voltage transmission and electric traction opened up wide new prospects. Lord Chandos ended by welcoming the guests in witty terms.

Mr. Emanuel Shinwell, a former Minister of Fuel and Power, replied for the guests, mentioning his part in the nationalisation of electricity supply and expressing his confidence in the future of the industry and of the country.

A fuller account of the speeches will appear in next week's issue.

Mr. D. Bellamy, O.B.E., vice-chairman, presided at the subsequent annual general meeting in the absence abroad of the chairman, Mr. C. R. King. After the adoption of the report and accounts, Mr. Bellamy reported that Lord Chandos had accepted the Council's invitation to continue as president for a further year and that Messrs. H. H. Mullens, H. J. Randall, S. F. Steward and E. R. Wilkinson had been appointed vice-presidents for 1956-59. The proceedings concluded with votes of thanks to Mr. King and to all who had helped the Association during the past year.

Mr. Bellamy has been elected chairman of the Council for 1956-57 and Mr. W. S. Lewis, C.B.E., vice-chairman.

Welding Special Metals

A PAPER by Dr. F. G. Cox, B.Sc., on "Welding and Brazing Refractory Metals," dealing particularly with molybdenum, niobium, tantalum and zirconium, is published in the *Review* (No. 16) of Murex, Ltd. In view of the growing importance of these materials, particularly in connection with nuclear energy developments, we give below a summary of the paper.

Final choice of a method for joining all metals depends on the use to which the fabricated part is to be put. This is still the major factor when considering the fabrication of zirconium, tantalum, niobium and molybdenum, but the methods available introduce considerable limitations. However, despite these limitations, it is usually possible to obtain satisfactory results. The methods available for welding and brazing zirconium, tantalum, niobium and molybdenum have been detailed in the text, but the methods applicable to each metal are summarised in table form.

Tantalum, niobium and zirconium should, whenever possible, be joined by the argon arc welding process or by electric resistance welding, the former being of more use for sheets thicker than, say, 0·015in and the latter for thinner sheets. Brazing methods are of use for joining to a dissimilar metal, but here again resistance welding should be considered.

The brittleness of molybdenum limits the use of welded joints and makes arc welding an impracticable process except in limited cases of particular joint design. Resistance welds, though also brittle, are less drastically affected and by suitable joint reinforcement stresses in the weld can be reduced to a safe level. Brazing is a simpler technique with molybdenum than with the other three metals and can often be used with advantage—particularly the hydrogen furnace brazing technique, which cleans and protects the molybdenum surfaces, allows only partial recrystallisation, and results in a joint which subsequently can be used up to moderately high temperatures.

Export and Exhibitions

MR. A. H. CARMICHAEL, director of the Cable Makers' Association, writes:—Your leader of 20th April brings out one of the most important aspects of the problem created by the Government's decision to withdraw its support from the London section of the British Industries Fair. We ourselves were not satisfied with the Electrical Section in Birmingham but we decided to support that Section when it was moved to London.

The Exhibition organised by the Association of Supervising Electrical Engineers is, within its present limits, excellent and deserves the fullest encouragement, but it is problematical whether it can take the place of the national B.I.F. and encourage overseas buyers to the extent required to show British electrical plant and equipment to the world.

There is a real need for an electrical exhibition of a wide character in London, preferably at the same time as the B.I.F. in Birmingham, which will attract overseas customers of the quality and in the numbers desirable.

Keadby Power Station

KEADBY, near Scunthorpe, was the scene on Friday, 20th April, of the opening ceremony for yet another Trent-side power station. At the entrance a commemorative plaque was unveiled by Sir Henry Self, K.C.B., K.C.M.G., K.B.E., Comp.I.E.E., deputy chairman (administration), Central Electricity Authority, who officially commissioned the station. It is the first C.E.A. station to be the subject of such a ceremony with its maximum installed plant capacity (360,000 kW) in operation. A dedication prayer was then offered by the Reverend Wallace Jones.

After a buffet lunch speeches were made by Mr. G. A. Vowles, O.B.E., divisional controller, Yorkshire Division, C.E.A., who presided and welcomed the guests; Sir Henry Self; and Mr. C. G. Richards, M.Sc.Tech., chief generation engineer (operation), who proposed a vote of thanks to the contractors and consultants. The reply on behalf of the contractors and consultants was made by Sir Claude Gibb, C.B.E., chairman and managing director of C. A. Parsons & Co., Ltd., and Sir Kenneth Hague, deputy chairman and managing director of Babcock & Wilcox, Ltd.

Both Sir Henry Self and Sir Claude Gibb criticised the current Government policy of cutting back the investment in power stations; this, they said, would make it impossible for this country to keep pace with the annual increase in demand for electricity of 8 to 10 per cent and be competitive with the estimated 1970 position in Europe when it was expected 75 per cent of all energy consumed would be electrical.

"Heads in the Sand"

IN a leaderette bearing this heading in our last issue we mentioned that we had been asked not to publish part of one of the papers presented at the E.D.A. annual conference. This was a comparison of the costs of gas, coal and electricity and we thought that it could not be construed as "knocking" the gas industry. It seems that our leaderette has been taken to imply that the Ministry of Fuel and Power has taken recent action in this matter. This is not so: all we were complaining of was that excessive caution had been engendered by earlier requests from the Ministry.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Dr. Willis Jackson, F.R.S., who was Professor of Electrical Engineering at the Imperial College of Science and Technology, London, has been elected to an honorary fellowship of the College. Another honorary fellow is **Sir William Penney,** F.R.S., director of the Atomic Weapons Research Establishment, a member of the governing body of the College.

The Minister of Fuel and Power has made the following appointments and reappointments to Electricity Boards:—

SOUTH EASTERN.—**Mr. H. E. Carpenter,** C.B.E., F.C.I.S., F.S.A.A. (appointed part-time member). Mr. Carpenter was secretary of the British (now Central) Electricity Authority from 1947 to 1951, and he became chairman of the Cyprus Electricity Authority in December, 1953.

EAST MIDLANDS.—**Mr. FitzHerbert Wright** (appointed part-time member) and **Ald. A. Sturgess,** O.B.E., J.P. (reappointed part-time member). Mr. Wright was formerly managing director of Aveling & Barford, Ltd.

YORKSHIRE.—**Mr. J. C. M. MacLagan,** M.I.C.E. (reappointed part-time member). **Ald. R. Barber,** J.P., and **Ald. J. H. Bingham,** LL.D., J.P., retired from the Board on 31st March on completion of their terms of office.

The A.E.I. Lamp & Lighting Co., Ltd., announces the appointment of regional managers for the North-West and South-West Regions.

Mr. F. C. Tyrrell, regional manager, north-west region, was with Siemens

Mr. F. C. Tyrrell

Mr. S. G. Turner

Brothers & Co., Ltd., from 1919 to 1923 when he joined the Metropolitan-Vickers Electrical Co., Ltd., at Southampton. He became lamp sales superintendent for the Bristol and S. Wales area and in 1933 moved to the Metro-Vick Manchester office, covering the North of England and Ireland.

Mr. S. G. Turner, regional manager, south-west region, was lamp and lighting superintendent, Cardiff, of the Metropolitan-Vickers Electrical Co., Ltd., from 1942 to 1953, when he was appointed superintendent, Lamp and Lighting Department, London. He is a fellow of the I.E.S. and a corporate member of the South Wales Institute of Engineers. Mr. Turner is the author of several papers on lighting technique and a lecturer to the International Museums Convention.

Mr. G. T. W. Whitehead, O.B.E., M.I.Mech.E., general manager (works), has been appointed a director of

Mr. G. T. W. Whitehead

Mr. J. B. McRostie

Johnson & Phillips, Ltd. Mr. Whitehead, who was awarded the O.B.E. for work on the "Pluto" operation, has served the company for forty-one years.

Mr. J. B. McRostie, B.Sc.(Eng.), A.M.I.E.E., general sales manager of Johnson & Phillips, has been invited to join the board. He received his technical training at Northampton Engineering College and has been with the company since 1946.

Mr. R. C. Thompson, C.B.E., M.A., chairman of Joseph L. Thompson & Sons, Ltd., has been elected president of the North East Coast Institution of Engineers and Shipbuilders for 1956-57.

Mr. A. J. Philpot, C.B.E., M.A., B.Sc., F.Inst.P., who has been with the British Scientific Instrument Research Association since 1920 and has been director of research since 1937, is retiring in June. His successor will be **Mr. J. Thomson,** M.A., Ph.D., D.Sc., M.I.E.E., who has been deputy director of physical research at the Admiralty since 1951. Before that Dr. Thomson was Professor of Physics and Electrical Engineering at the Royal Naval College, Greenwich.

Thorn Electrical Industries, Ltd., announces that **Mr. G. N. Leaf** has been appointed manager of its export division and assumes responsibility for overseas sales of "Atlas" lamps and lighting equipment, Ferguson radio and television receivers and "Tricity" cookers. Mr. Leaf, who has been with the company since 1931, recently returned to the United Kingdom from an extensive tour in Australia and New Zealand in connection with the establishment of subsidiaries in those countries.

The article in this issue on "Turbovisory Gear" is written by two members of the Metropolitan-Vickers Electrical Co., Ltd. **Mr. A. H. Gray,** M.Sc., M.I.E.E., is section leader in charge of regulator and turbovisory gear in the Instrument and Meter Engineering Department. He received his technical education at Leeds University, taking his M.Sc. degree in 1921. He joined Metropolitan-Vickers as a college apprentice in the following year and on completion of his course joined the Instrument and Meter Department. He is author and joint author of a number of papers, the most recent being "The electrical measurement of steam turbine rotor movements" which was written in conjunction with Mr. Hall and read before the I.E.E.

Mr. J. S. Hall, B.Sc.Tech., A.M.I.Mech.E., is assistant chief engineer, Steam Turbine Engineering Department. He was apprenticed with Vickers, Ltd., at Barrow-in-Furness and took his degree at Man-

Mr. A. H. Gray

Mr. J. S. Hall

chester College of Technology. He joined Metropolitan-Vickers in 1927 and was for many years engaged in development work, being associated, for instance, with high-pressure high-temperature steam turbine plant, marine gas turbines, jet engines, marine steam turbines and large steam turbines for the Central Electricity Authority.

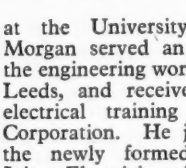
In addition to the twelve apprentices of **E. K. Cole, Ltd.,** who were presented with national certificates by Mr. T. L. Morgan, principal of the Southend-on-Sea Municipal College, on 18th April, student apprentice David Everett received his B.Sc. (general). The presentation took place in the Ekco club-house following a tour of the factory by parents of the

apprentices. The visitors were welcomed by Mr. F. S. Allen, works director.

Mr. F. Morgan, A.M.I.C.E., A.M.I.E.E., has been appointed No. 3 sub-area engineer for the Merseyside and North Wales Electricity Board at Chester in succession to **Mr. T. V. Lironi,** who has taken up an appointment in British Columbia, Canada. Educated at the Leeds Central High School and at the University of Leeds, Mr. Morgan served an apprenticeship at the engineering works of Towler Bros., Leeds, and received early civil and electrical training with the Leeds Corporation. He joined the staff of the newly formed West Midlands Joint Electricity Authority in 1927 where he was engaged first on extensions and new power stations, and later on the development of the Authority's distribution area in Shropshire. In 1942 he was appointed power sales engineer to the Stalybridge Electricity and Transport Board, and in 1947 became deputy electrical engineer and manager of the Chester electricity undertaking where, since nationalisation, he has been the deputy sub-area engineer.

Mr. F. Morgan

Mr. G. A. G. Ive has been appointed managing director of Radiovisor Parent, Ltd., in succession to the late Mr. E. Harley Bell. Mr. Ive first became associated with the company over twenty-five years ago.



Mr. G. A. G. Ive

During the war he served with the Admiralty, rejoining Radiovisor Parent, Ltd., as chief engineer in 1947; in 1950 he was appointed technical director. In the post-war period he has initiated many of the developments which have taken place in the application of Radiovisor photo-electric equipment to industrial control and measuring problems.

Mr. L. A. Stride, vice-chairman of Allen West & Co., Ltd., has retired because of advancing years. He is succeeded by **Mr. M. A. Stride** and **Mr. G. H. Cann** has been co-opted to the board.

Mr. J. Halkett is retiring from the position of station superintendent, Ferrybridge "A" power station of the Yorkshire Division, C.E.A. He first went to the station as charge engineer during the latter stages of the construction period in 1926 and with successive promotions became station superintendent in 1947. Before going to Ferrybridge, he gained experience at Stalybridge, Palmers (of Jarrow) and Wednesbury.

Mr. L. T. Giles, Associate I.E.E., M.Inst.F., hitherto station superintendent, Mexborough, has been appointed station superintendent at Ferrybridge "A." Educated at Cedars House School, Ealing, and the Grammar School, Southend-on-Sea, Mr. Giles entered the industry in 1927, serving an apprenticeship with the Guildford Corporation Electricity Department. From 1932 to 1950 he held various positions at Guildford, Letchworth, Slough Trading Estates, Ltd., and Portishead power station, Bristol. In 1950 he was appointed station superintendent, Barugh, Barnsley and Wakefield power stations, and became station superintendent at Mexborough in 1951.

Mr. A. F. Vowles, A.M.I.E.E., deputy station superintendent, Connah's Quay power station, has been appointed station superintendent, Mexborough. After an apprenticeship with C. A. Parsons & Co., Ltd., and service in H.M. Forces, Mr. Vowles held successive appointments at Meaford power station, leading to shift charge engineer. He was turbine house superintendent at Ferrybridge power station from September, 1952, to September, 1953, when he was appointed deputy station superintendent at Connah's Quay.

Mr. M. J. Cheesman has been appointed chief designer to Transformers & Rectifiers, Ltd. He was formerly the southern area representative of Brentford Transformers, Ltd.

A plea to all electrical engineers in Northern Ireland to give their support and encouragement to the new Electrical and Mechanical Engineering Department being established at Queen's University, Belfast, was made by Dr. Willis Jackson, director of research and education with the Metropolitan-Vickers Electrical Co., Ltd., and vice-president of the Institution of Electrical Engineers, at the annual dinner of the **I.E.E. Northern Ireland Centre** in Belfast on 20th April. The dinner, at which Major E. N. Cunliffe, chairman of the Centre, presided, was also addressed by Ald. R. J. R. Harcourt, the Lord Mayor. A dance which followed was attended by more than 150 members and guests.

Nearly 400 members and friends of the **B.T.H. (Willesden) Long Service Association** attended the tenth annual reunion at Wembley Town Hall on 17th April. Originally formed in 1931, the Association now has a membership of 303 and this year has added twenty-seven members (employees who have served the company for twenty-five years) and another sixteen members qualified for certificates marking thirty years' service. The principal guest was Mr. W. S. Steel, director, sales (plant and apparatus), who was introduced by Mr. C. F. Humphreys, manager, Switchgear Engineering Department, and chairman of the Association. Dancing and an excellent cabaret rounded off a successful social evening.

The new president of the Birmingham Exchange and Engineering Centre is **Mr. Victor Brenner,** managing director of Deutsch & Brenner, Ltd., metal merchants, of Birmingham, and a past treasurer of the Centre. He succeeds **Mr. C. J. Grazebrook,** joint managing director of M. & W. Grazebrook, Ltd., ironfounders, who has been president for the last four years.

Mr. J. H. Pennington has been appointed manager of Technical Ceramics, Ltd., of Towcester, Northants, a newly formed company for the development and exploitation of ultrasonic materials and techniques. For the past two years Mr. Pennington has been in charge of special products at the pilot plant of the chemical and metallurgical division of the Plessey Co., Ltd., at Towcester, Northants. Before joining Plessey he spent some years with E. K. Cole, Ltd., as technical representative. Among the activities that Mr. Pennington will direct at Technical Ceramics will be the development of new applications for piezo-electric ceramics.

Mr. J. H. Pennington

Mr. P. Philip, O.B.E., M.I.E.E., M.I.Mech.E., area manager for Dundee of the North of Scotland Hydro-Electric Board, is to retire from that post in July. He will continue to act for the Board in an advisory capacity. **Mr. R. B. Anderson,** M.I.E.E., M.Am.I.E.E., who is at present manager of the northern area, which covers Caithness, Sutherland and part of the counties of Ross and Inverness, succeeds Mr. Philip as area manager at Dundee.

Mr. Philip joined the Dundee electricity undertaking in 1908 while the

ELECTRICAL WHO'S WHO

The 1956–57 edition of the "Electrical Who's Who" is now available from Iliffe & Sons, Ltd., Dorset House, Stamford Street, S.E.1. This edition has been considerably enlarged and contains some 7,000 entries in addition to the index in which names in the biographical section are classified under companies or other organisations. The price remains at 21s (postage 1s 5d)

Carolina port power station was under construction. He was appointed city electrical engineer in 1941.

Mr. Anderson has been manager of the northern area since 1951. He was formerly with the Grampian Electric Supply Co. and later with the North of Scotland Hydro-Electric Board at Perth as distribution engineer and deputy area manager.

Sir Ronald W. Matthews, D.L., chairman of the Brush Group, Ltd., has announced his intention to retire from the chairmanship after the annual meeting on 17th May. He will, however, continue to serve on the board. Sir Ronald will be succeeded as chairman by **Mr. G. C. R. Eley,** C.B.E., M.A., the present deputy chairman.

It has been announced by the British Electrical and Allied Manufacturers' Association that the president, **Viscount Chandos,** the chairman, **Mr. E. H. Ball,** and the vice-chairman, **Mr. J. O. Knowles,** are continuing in office for a further year.

The South West Area of the **Electrical Industries National Golf Championship** will hold its annual qualifying match at Yelverton Golf Club, South Devon, on 3rd July, when an 18-hole medal will be played in the morning and a foursomes game in the afternoon. There will be a dinner in the clubhouse. Score cards can be obtained from the hon. golfing secretary, Mr. A. Hughes, British Insulated Callender's Cables, Ltd., 7-9, Barton Street, Bristol.

The South Eastern Area final of the championship will be held on 29th June at Addington, Surrey. An open competition and a visitors' competition will be played in the afternoon. Qualifying cards can be obtained from the area secretary, British Insulated Callender's Cables, Ltd., 59a, Middle Street, Brighton, 2s 6d each.

Mr. F. L. Woodcock has been appointed manager of the London district of Electrolux, Ltd., following the death of Mr. H. S. Hadley. Mr. Woodcock joined the company in 1938 and since the war has been at the head office where he has been mainly concerned with refrigerator sales promotion.

The annual general meeting of the **Exeter Electric Club** was held at the Imperial Hotel, Exeter, on 19th April, when the following officers were elected:—President, Mr. P. Tracy; vice-president, Mr. W. Hallam; hon. secretary, Mr. A. W. Hicks; hon. treasurer, Mr. J. Rothera. Mr. Hicks was presented with a fishing rod, in appreciation of his services during the past year, by the immediate past-president, Mr. H. Bicker. The Social Committee was thanked for the functions which it successfully organised, and its members were returned to office *en bloc* with an additional membership of two. It was decided to donate 21 guineas to the Electrical Industries Benevolent Association. The "Peters Cup" is this year to be presented to the winner of the treasure hunt which is to take place during May.

Mr. H. Chilton, B.Sc., A.M.I. Chem.E., who writes in this issue on "Cooling Tower Design," served his apprenticeship with the North Eastern Marine Engineering Co., Ltd., Sunderland, and concurrently studied at the Sunderland Technical College under the "sandwich" scheme, receiving his B.Sc. degree from Durham University in 1939. After completing his apprenticeship, Mr. Chilton served as an engineer officer in the Merchant Navy until 1947 when he joined the Research Department of Imperial Chemical Industries, Ltd., at Billingham where he specialized in water cooling and other mass-transfer processes. In 1949 he joined the British Electricity Authority as head of a research section investigating water cooling and other special problems in connection with generating plant. He was appointed technical director of Cooling Towers, Ltd., in 1953 and still serves the company in a consultative capacity. In 1955 he took up his present position as head of a group of engineers and scientists employed by C. A. Parsons & Co., Ltd., co-operating with the Atomic Energy Research Establishment at Harwell in the development of nuclear power plant.

Mr. H. Chilton

Mr. G. Boor, who retired recently from the estimating section of the Switchgear Engineering Department of the Metropolitan-Vickers Electrical Co., Ltd., had completed more than fifty-three years' service at Trafford Park. He has received various farewell gifts from his colleagues and from the M-V Long Service Association. The presentation from his colleagues was made by Mr. E. Nicholson, chief engineer of the Switchgear Department, and that from the Long Service Association by Mr. S. Boardman.

The golf competitions run for the benefit of the Electrical Industries Benevolent Association at the **British Electrical Power Convention** at Torquay will be held in the morning and afternoon of Saturday, 26th May. The ladies' competition for the Lady Citrine Rose Bowl will be played at the Torquay Golf Club and the men's competition for the G. P. Dennis Trophy will be played at Churston Golf Club. These competitions are not confined to delegates and *bona fide* members of the electrical industry are welcome. Non-delegates wishing to enter should get in touch with Mr. C. F. Boyes at Magnet House, Kingsway, London, W.C.2 (after 22nd May at the Livermead Cliff Hotel, Torquay; telephone: Torquay 316711).

OBITUARY

Mr. Vernon Young, F.C.I.S., whose resignation for health reasons as secretary of International Combustion (Holdings), Ltd., was reported in our last issue, died on 18th April. Mr. Young was a director of the company and of its subsidiary companies.

Mr. K. A. Mountain.—The death is reported, at the age of sixty-eight, of Mr. Kenneth A. Mountain, of Alnmouth, Northumberland, who had served on the sales side of British Insulated Callender's Cables, Ltd., Newcastle-on-Tyne, for some years. He was mainly concerned with the electric wiring of shipping in the Tyneside area. For many years he was with the old Callender's Cable & Construction Co. Mr. Mountain's father was a member of the firm of Scott & Mountain.

Mr. L. M. Glancy.—The death occurred on 17th April of Mr. Louis Mark Glancy, J.P., a director of Thorn Electrical Industries, Ltd. In 1936 his business interests in Manchester were acquired by Thorn Electrical Industries, whose northern branch in Manchester was managed by Mr. Glancy. In 1939 he was appointed to the board, retiring from active business in 1950 owing to ill-health.

Mr. William Henry Harrison, president of the International Telephone & Telegraph Corporation, has died at Garden City, New York State, at the age of sixty-three.

WILLS

Mr. H. Allcock, export manager to W. T. Glover and Co., Ltd., and chairman of the Decimal Association, who died on 21st January last, left £15,002 gross (£14,829 net).

Mr. S. C. Bradley, proprietor of W. Bradley and Son, electrical contractors, who died on 5th December, left £2,972 gross (£2,900 net).

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £189 0s 0d
COPPER, H.C. Electro	ton £370 5s 0d
Fire Refined 99·70%	ton £369 0s 0d
Fire Refined 99·50%	ton £368 0s 0d
COPPER Tubes ..	lb 3s 6d
Sheet	ton £445 5s 0d
H.C. wire and strip ..	ton £406 5s 0d
LEAD, English ..	ton £113 15s 0d
Foreign	ton £112 0s 0d
MERCURY	flask £85 0s 0d
TIN, block (English) ..	ton £758 10s 0d
ZINC, G.O.B. Foreign	ton £98 5s 0d
Electrolytic	ton —
BRASS TUBES (solid drawn)	lb 2s 9½d
Sheet	ton £350 15s 0d
Wire	lb 3s 6½d
PHOSPHOR BRONZE Wire	lb 5s 2½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 26¾d—27¼d

OVERSEAS ELECTRICAL TRADE

Exports Rise by £4·8 Million in First Quarter

WITH the publication of the export figures for March, the trend of electrical exports for the first quarter of the year is shown. While the March total of £17,019,203 represents a small falling-off as compared with the £17,071,601 for the preceding month, the total for the three months of £52,983,879, compares favourably with that of £48,169,875 for the corresponding quarter of 1955. Exports of generators and motors rose from £2,420,101 in February to £2,482,701 last month, but it will be seen from Table I that the total for the quarter was lower at £8,363,715, as compared with £9,320,952 for January-March, 1955. The Dominions were again the principal markets, Australia taking plant valued at £302,534, South Africa £242,160 and India £203,629. Exports of converting machinery, mercury-arc rectifiers, switchgear, etc., were valued at £2,469,952, a little lower than the figure of £2,581,425 for the corresponding month last year, and South Africa was once again the chief purchasing country with the total value of £408,141. Other important purchasers were Australia (£301,250), India (£289,767) and Canada (£225,370).

Although there was a slight slackening in the demand for electric cables, wires, etc., as compared with February, the exports at £2,641,227 were higher than the figure of

TABLE I.—ELECTRICAL EXPORTS

Class	March 1956	Three months ended March 1955	Three months ended March 1956
	£	£	£
Generating sets and generators:			
Diesel-driven, up to 10 kW	150,716	406,913	366,929
Ditto, 10 to 65 kW	127,913	401,579	336,753
Ditto, 65 to 200 kW	83,397	233,336	361,708
Ditto, over 200 kW	218,179	1,696,925	933,505
Spark ignition engine driven	39,819	70,809	127,560
Steam turbine driven	37,705	416,616	71,023
Hydraulic turbine driven	—	172,417	51,786
Other prime mover driven	14,492	98,843	96,732
Generators, not exceeding 200 kW	90,641	418,475	408,168
Ditto, over 200 kW	80,504	329,271	229,932
Parts of generators	514,947	1,675,096	1,866,464
Motors, complete, other than railway, tramway and trolley-bus:			
Up to ½ h.p.	194,586	681,201	600,938
Over ½ but under 1 h.p.	51,393	205,154	177,170
1 h.p. to 250 h.p.	428,508	1,193,327	1,325,283
Over 250 h.p.	65,725	293,626	167,370
Railway, tramway and trolley-bus motors complete and parts of all motors	151,729	404,567	530,499
Motor starting and controlling gear	232,447	622,797	711,895
	2,482,701	9,320,952	8,363,715
Converting machinery	33,090	170,855	101,805
Mercury-arc rectifiers	54,447	193,260	211,243
Transformers for lighting, heating and power (incl. coils)	1,065,664	2,782,560	3,094,734
Switchgear and switchboards (not telegraph or telephone), up to 200 A and 660 V	283,911	998,919	730,292
Ditto, other	1,032,840	3,105,606	3,470,868
	2,469,952	7,251,200	7,608,942
Primary batteries:			
Lighting	75,623	209,718	250,651
Radio	276,193	489,505	714,964
Other	51,212	122,734	139,414
Parts (excl. carbons)	47,214	89,287	128,093
Lamps:			
Filament, exceeding 24 V	108,262	284,986	304,865
Ditto, under 24 V	31,882	91,499	94,737
Arc lamps and searchlights	27,710	45,305	60,095
Discharge lamps, fluorescent tubes, etc.	73,562	219,171	223,810
Radio and television, etc., apparatus:			
Thyratrons, hot cathode mercury vapour and gas-filled rectifiers (excl. mercury arc rectifiers), photo-electric cells, stabilising and cold cathode valves, magnetrons, klystrons	15,427	88,785	70,672
Cathode-ray tubes	16,925	28,228	45,025
Other valves (not X-ray)	162,062	556,324	537,988
Parts (excluding glass bulbs)	16,801	59,877	53,116
Radio and television transmitters	75,937	137,307	212,709
Commercial radio and radar equipment	1,149,883	2,732,195	3,416,563
Domestic radio receivers, mains	151,588	551,198	488,491
Ditto, battery	66,502	185,946	234,944
Ditto, other (incl. car)	30,637	51,148	86,640
Radiograms	25,898	157,085	105,739
Television sets	29,696	22,065	139,413
Public address equipment	83,456	215,395	263,564
Sound reproducing app., n.e.s.	26,493	68,835	109,432
Components and parts, n.e.s.	681,352	1,688,316	1,953,737
	2,532,657	6,542,704	7,718,033
Telegraph and telephone installations	440,574	2,250,900	1,838,802
Telephone instruments, separately consigned	133,131	202,298	351,509
Telegraph and telephone parts	536,793	1,382,957	1,706,288
Line apparatus for long distance commun.	159,920	241,188	344,014
	1,270,418	4,077,343	4,240,613

Class	March 1956	Three months ended March 1955	Three months ended March 1956
	£	£	£
Cookers	90,780	503,618	270,928
Toasters	22,160	82,586	65,745
Other cooking apparatus	37,384	103,241	110,312
Parts and accessories	94,250	190,642	252,308
Space heating appliances	44,759	142,450	156,034
Water heating appliances	37,563	94,301	97,639
Other heating appliances	61,108	99,411	117,328
Parts and accessories	68,996	195,257	201,785
Irons	123,991	334,018	341,408
Arc welding equipment, a.c.	87,397	114,770	182,723
Ditto, d.c.	48,306	88,037	121,481
Resistance welding equipment	16,462	59,494	62,255
Electric furnace plant	57,184	125,079	169,059
Magnetos, ignition	22,090	50,454	89,335
Sparking plugs	164,734	460,384	470,586
Elec. appliances for aeroplanes, n.e.s.	190,135	532,377	553,362
Ditto, for motor vehicles, n.e.s.	387,536	887,166	1,051,816
Ditto, for cycles, n.e.s.	89,020	234,392	245,729
Signalling app. (incl. traffic signals)	71,533	127,222	173,119
Industrial radio-frequency equipment	18,790	46,522	32,903
Bell app. (not telegraphic or telephonic)	8,132	27,199	28,134
Instruments, commercial	186,257	465,879	526,018
House service meters (including parts)	167,367	399,659	540,931
Electro-medical apparatus (not X-ray)	64,920	137,741	202,839
X-ray apparatus (excl. tubes and valves)	86,982	169,771	206,426
Vacuum tubes	27,643	76,994	73,334
Ceiling fans, complete	105,633	299,864	301,733
Desk fans, complete and parts of desk and ceiling fans	34,406	90,278	80,247
Vacuum cleaners	120,561	449,933	396,429
Floor polishers	84,943	248,820	256,986
Food mixers	57,705	142,361	185,471
Hair clippers and dry shavers	71,088	273,652	270,091
Other portable appliances	29,062	174,259	87,872
Parts	170,407	210,422	366,340
Portable elec. tools (not saws) and parts	211,266	575,942	577,802
Cables and wires:			
Telegraph and telephone, submarine	26,232	325,513	103,317
Ditto, other	819,002	1,383,371	2,376,308
Cotton, silk or art. silk insulated	79,218	155,119	186,345
Enamel, glass or asbestos insulated	64,816	235,733	232,524
Paper insulated	827,546	1,958,121	3,187,151
Rubber insulated	503,300	1,505,199	1,534,842
Thermoplastic insulated	139,836	199,788	404,426
Other	181,277	541,457	693,978
	2,641,227	6,304,301	8,718,891
Accumulators for motor vehicles	175,777	444,925	557,762
Ditto, traction	18,214	47,402	70,005
Ditto, radio and other portable	68,150	179,252	250,031
Ditto, other	35,805	79,600	162,531
Parts and accessories	64,472	285,007	257,268
Elec. porcelain, etc. (incl. insulators)	110,291	282,092	306,045
Insulating cloth and tape	60,995	200,652	201,200
Other insulating material	103,910	280,457	290,784
Permanent magnets	54,730	144,172	130,431
Radio, telegraph and telephone testing equipment, n.e.s.	29,621	128,083	91,320
Scientific elec. instruments (not telegraphic or telephonic):			
Time recorders and time switches, complete	11,753	101,527	36,184
Other	191,058	701,550	596,703
Electrical machinery, n.e.s.	102,627	261,968	361,969
Electrical apparatus and appliances, n.e.s.	742,637	1,770,278	2,238,315
TOTAL	17,019,203	48,169,875	52,983,879

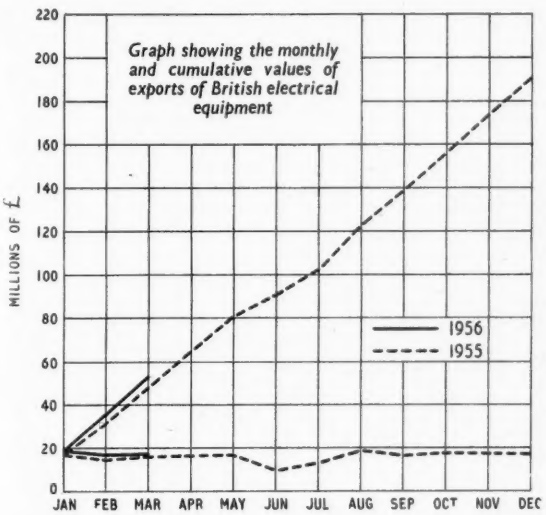
TABLE II.—DISTRIBUTION OF EXPORTS OF ELECTRICAL MACHINERY, APPARATUS AND APPLIANCES

Country	March, 1956	Three months ended March, 1955	Three months ended March, 1956
	£	£	£
Channel Islands	67,834	160,751	228,861
Gibraltar	14,718	96,945	43,057
Malta and Gozo	67,387	199,750	242,149
Cyprus	222,645	323,132	457,275
Sierra Leone	36,861	105,310	83,264
Gold Coast	184,952	401,452	472,643
Nigeria	288,931	641,255	940,013
Union of South Africa	1,382,675	4,709,257	4,213,981
Rhodesia and Nyasaland	588,309	1,154,706	1,783,512
Tanganyika	53,068	217,497	174,221
Kenya	189,732	452,834	636,621
Uganda	54,220	252,968	207,691
Anglo-Egyptian Sudan	77,761	332,337	179,201
Mauritius	24,012	105,479	75,551
Aden	45,701	161,798	168,350
Bahrain, Qatar and Trucial States	100,487	221,330	281,793
Kuwait	85,958	306,103	275,628
India	1,297,873	4,269,825	5,159,217
Pakistan	223,705	1,039,765	842,056
Singapore	287,851	1,018,656	861,200
Federation of Malaya	321,974	751,519	821,662
Ceylon	139,083	343,457	434,940
British North Borneo	9,072	87,345	105,925
Sarawak	7,536	70,744	63,619
Hong Kong	212,004	525,062	559,099
Australia	1,685,490	5,159,661	5,311,317
New Zealand	740,749	3,910,713	2,761,998
Fiji	21,592	92,730	51,774
Canada	838,393	1,669,992	2,284,134
Jamaica	129,580	230,134	343,864
Barbados	45,671	61,277	109,129
Trinidad	130,117	295,726	355,759
British Guiana	30,644	141,829	124,469
Other Commonwealth countries	94,799	370,697	238,741
Irish Republic	292,403	1,002,150	903,460
Soviet Union	215,948	565,686	812,236
Finland	168,758	329,207	426,894
Sweden	401,946	972,366	947,925
Norway	233,971	1,040,288	594,426
Iceland	6,014	41,456	42,626
Denmark	215,491	368,356	503,211
Poland	54,034	84,750	106,903
Western Germany	177,336	486,567	528,581
Netherlands	608,558	1,538,032	1,715,203
Belgium	289,471	696,678	849,395
France	302,447	684,599	927,079
Switzerland	96,068	216,800	288,446
Portugal	135,551	844,743	470,372
Spain	122,127	393,809	501,173
Italy	368,798	590,771	954,781
Austria	14,047	106,748	140,211
Yugoslavia	57,787	158,716	252,507
Greece	227,140	326,484	471,547
Turkey	143,937	284,599	267,092
Belgian Congo	38,281	125,567	101,821
French Morocco	43,051	92,496	138,920
Portuguese East Africa	26,971	73,869	73,830
Egypt	202,568	413,011	538,446
Libya	34,995	43,734	57,146
Syria	45,223	90,231	129,112
Lebanon	80,016	88,745	147,067
Israel	60,918	115,942	185,980
Jordan	28,488	88,349	167,891
Saudi Arabia	126,444	221,800	257,739
Iraq	267,208	633,003	992,754
Iran	179,697	163,440	621,479
Burma	199,468	585,097	496,171
Thailand	119,871	561,652	346,049
Indonesia	49,776	87,318	154,438
Japan	49,870	238,574	153,272
United States of America	598,637	828,687	2,320,387
Cuba	11,473	78,663	94,048
Mexico	70,268	88,371	186,318
Colombia	47,563	338,195	314,861
Venezuela	220,409	803,296	1,015,238
Peru	26,048	114,258	131,262
Chile	21,383	169,800	65,583
Brazil	293,129	148,088	705,604
Uruguay	8,909	119,110	26,528
Argentine Republic	90,755	497,097	186,183
Other foreign countries	244,568	746,641	778,970
TOTAL	17,019,203	48,169,875	52,983,879

£2,180,039 for March, 1955. India was the best customer with a value of £364,773, second place being taken by New Zealand with a value of £160,745. There was little change in the value of exports of telegraph and telephone equipment, the figure for March being £1,270,418, as compared with £1,361,453 in February, and £1,268,518 in March, 1955. Australia held the leading position with purchases of £292,539, followed by South Africa (£146,192) and New Zealand (£107,133). In Table II the exports in Table I are analysed according to destination.

In addition to the equipment shown in Table I, a number of electrical products are given in other sections of the official returns. These include electric washing machines, the exports of which in March were valued at £310,157 for machines up to 150 lb net weight (against £295,572 in March, 1955), £112,934 for machines over 150 lb net weight (£101,936), and £55,509 for parts (£75,197). The value of electric light fittings and lanterns, complete, with or without lamps, totalled £160,888 (£138,145 in March, 1955), electric locomotives, £100,124 (£214,136), and i.c. engine locomotives with electrical transmission £930,466 (£533,183).

Electrical machinery imports in March totalled £2,078,135, as compared with £2,184,177 in February, and £1,699,905 in March, 1955. The United States continued to be the principal supplier with a value of £529,278, second place being held by the Netherlands (£420,772), and third by Western Germany (£282,760).



Road Warming Experiment

RESULTS and consumption figures of the road warming by electricity experiment on the A.171 road at Ormesby Bank, between Middlesbrough and Whitby, have been collated and considered by the General Electric Co., Ltd., the North Eastern Electricity Board and the North Riding County Council.

During the period from 15th November to 10th March a 612 W element used in the experimental square yard patch of asphalt road surface on the bank consumed 473 kWh between the off-peak hours of 6 p.m. and 7 a.m., with a boost between noon and 3 p.m. when required. Average consumption, therefore, was just over 4 kWh a day.

The period of the test coincided with some of the most wintry weather experienced in recent years. Although the pilot patch was partly snow-covered during the heaviest falls the bottom layers were never frozen. The surface was completely clear during light snowfalls, and so was an appreciable part of the adjoining, untreated, asphalt. It was also completely clear of rime during all heavy white frosts throughout the winter.

More conclusive data is expected to be gathered next winter. Next month, when part of the bank's surface is relaid, elements are to be placed in a stretch 70ft long by 24ft wide.

Review of the Industrial Exhibits in London and Birmingham

BRITISH INDUSTRIES FAIR

SPEAKING at the formal opening of the British Industries Fair at Olympia, Mr. R. A. Butler, Lord Privy Seal, said that it was forty-one years since the British Industries Fair was established in London. Regret at the recent decision to withdraw support from the London section must be tempered by the recognition that in those years we had moved into a different time and tempo. In a sense, the B.I.F.'s very success had brought about its own demise. It had taught industry to be exhibition minded and as a result offshoots had sprung up in such numbers and strength as to overpower the parent tree. The B.I.F. was originally the only " shop window " in this country for displaying our goods, but since then there had been a great development both in the establishment of specialised exhibitions at home and in the expansion of international trade fairs overseas. For this and other reasons, the Government felt that the London Fair in its traditional form was no longer fulfilling a general need.

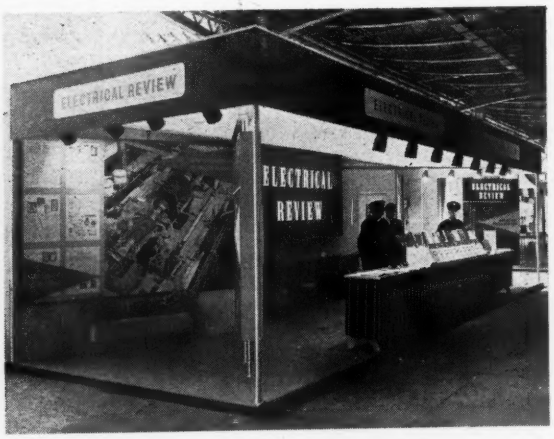
Mr. Butler went on to say that it was to the credit of Sir Ernest Goodale and his fellow directors and staff that they had shown so much energy and skill in their effort to put the Fair on a firm footing. This year for the first time they had tried out the brave experiment of a two-part fair in London.

Perhaps the outstanding item at Olympia, both in its novelty and significance, was the Atomic Energy exhibit which impressively demonstrated Britain's drive to harness nuclear power for peaceful purposes.

Replying to the toast of " British Industry " proposed by the President of the Board of Trade (Mr. Peter Thorneycroft) at the official banquet at the Mansion House, London, on Monday, Lord Chandos expressed annoyance with those people who alleged that the British working man would not work. He said he had found that there was industrial discipline based on confidence between the management and the workers. In the great majority of cases the tempo and standard of work were very high indeed.

At the Press view of the Castle Bromwich exhibits last Friday Mr. J. Ivan Yates, chairman of the Fair Management Committee, referred to the closing of the London section of the Fair and said that they in Birmingham were confident that there was a need for a large general fair of the nature of the B.I.F. This great exporting country could not afford to be without one.

Mr. Yates pointed to the many advantages offered by the Castle Bromwich buildings which, he said, formed the largest exhibition hall in the world on one floor. There was ample room for extension and exhibitors would find that there were better sites at lower cost than at any other trade show in the country. They believed that the B.I.F. could be made the finest national trade fair in Europe.



Visitors to Olympia requiring information about the electrical exhibits are invited to call at the "Electrical Review" stand (A.98)

OLYMPIA

THE official electrical section of the fair is this year at Olympia and although it includes only eighty-four exhibitors, in contrast, for instance, to the recent Electrical Engineers' Exhibition at which there were over 300, what is lacking in quantity is undoubtedly made up in quality. The standard realised by the individual exhibitors is very high, even those companies which have participated in both exhibitions seeming to have prepared altogether more lavish and interesting displays.

There is a curious mixture of domestic and industrial stands—rendered so because whereas at the A.S.E.E. exhibition last month the emphasis even by the heavy engineering firms was almost entirely on consumer goods and smaller items of equipment, at the B.I.F. such concerns are trying to show the wide variety of their products, with the emphasis, if anywhere, on the heaviest capital goods. Those stands which are purely domestic are mixed with the others without any underlying arrangement.

Dominating the Grand Hall is the 8,000 sq ft stand of the United Kingdom Atomic Energy Authority. This has a twofold theme. The first is to explain the Authority's programme of research and development by means of models and diagrams, and includes beautifully constructed models of the Calder Hall atomic power station, the

Dounreay reactor area, the DIDO research reactor and associated plant, now nearing completion at Harwell, and others.

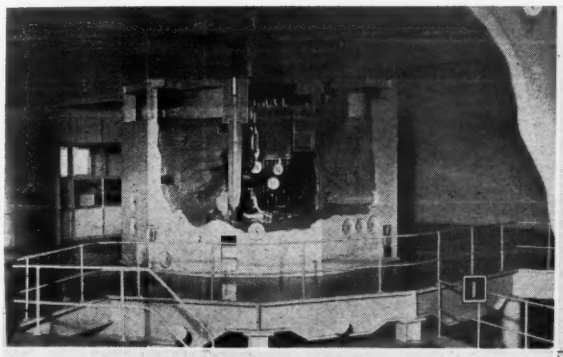
The second purpose of the stand is to show the uses of radioactive isotopes and some of the developments taking place. This is a field of activity in which almost every week sees an important addition to knowledge or experience and on this stand not only the latest knowledge but in many cases working demonstrations, are available to those interested. Another part of the stand houses the reactor simulator, for representing electronically all the variables present in a reactor and examining the theoretical behaviour of a given reactor under specific conditions. Examples of modern equipment for uranium prospecting, ranging in size from portable hand sets to more elaborate equipment suitable for aircraft surveying, are on view.

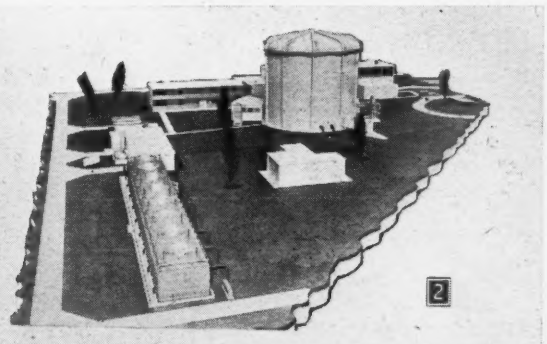
This stand is substantially the same as that which the Atomic Energy Authority had at the Geneva Conference of last August, but this is the first time such a comprehensive display has been seen in this country. It is undoubtedly of great interest to private individuals as well as to industrial representatives.

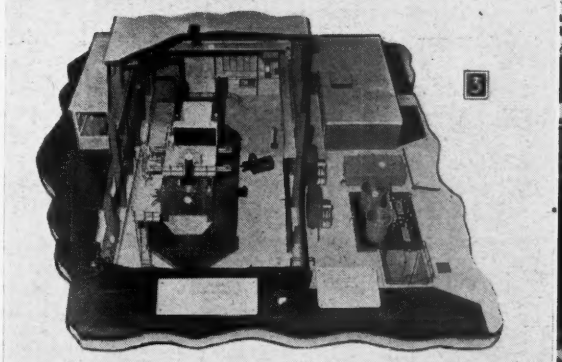
It is perhaps unfortunate that such a splendid exhibit could not have been supported by a reasonable number of other displays illustrating the many important items of nuclear plant now manufactured by British firms, and likely to be of growing importance to the world as atomic power develops.

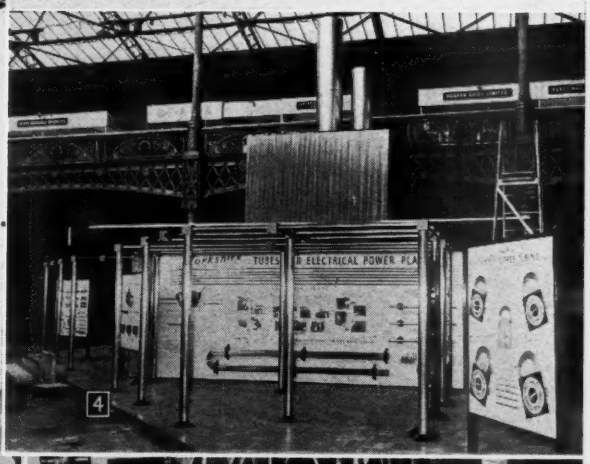
One stand which does contribute to this idea, however, is that of Imperial Chemical Industries, Ltd., and its associated company, Marston Excelsior, Ltd. Several examples are on view of pipework assemblies and heat

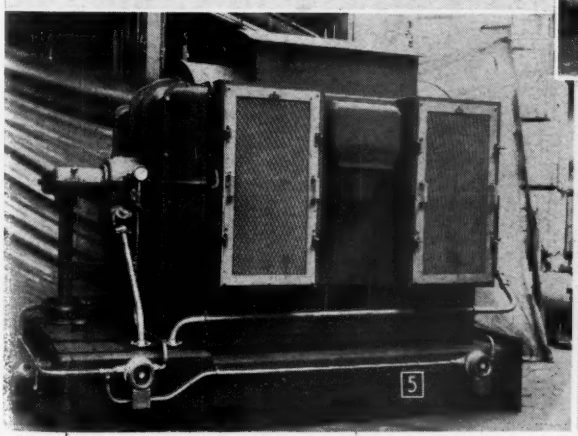
(1) Close up of a model of the DIDO reactor showing the detailed construction, and (2) a large model of the complete DIDO project, on the stand of the Atomic Energy Authority. (3) Model of the LIDO " swimming pool " type reactor project. (4) The stand of Yorkshire Copper Works is made entirely of non-ferrous metal tubes. (5) A Bruce Peebles 2,050 h.p. boiler feed pump motor and (6) one of their cold-rolled steel cored distribution transformers seen against a mining type battery charging rectifier

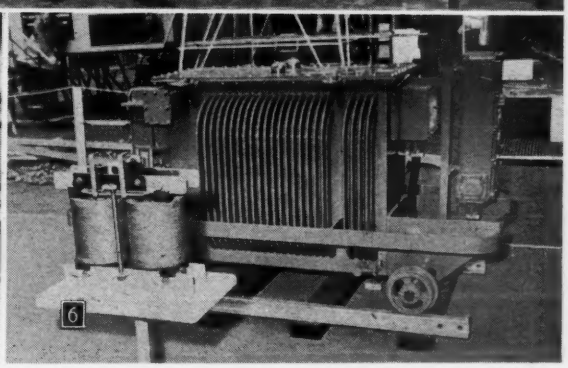










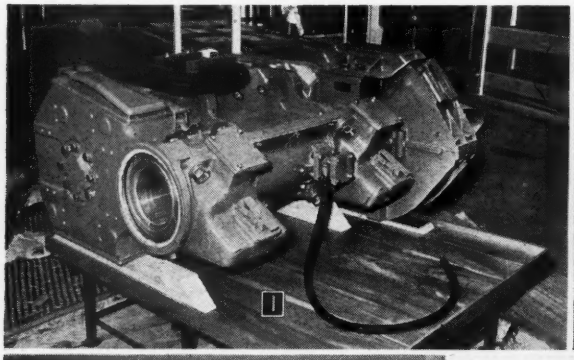


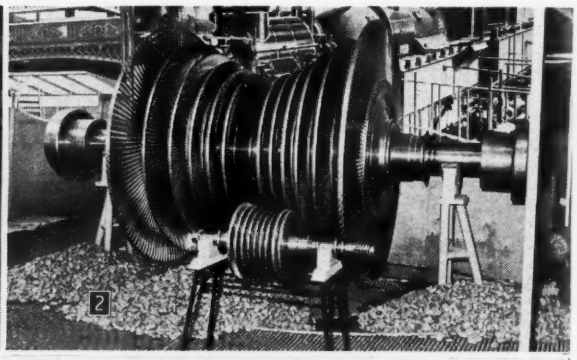
exchangers, fabricated out of aluminium alloys and other non-ferrous metals, and typical of such products used for atomic energy purposes. This company has also been concerned with the sheathing of uranium fuel rods, and reference to this aspect is made on the stand. An actuating mechanism for combined control and shut-off rods on thermal reactors, developed by Metropolitan-Vickers, is shown on their stand. The company is supplying 120 of these for the Calder Hall " A " station.

The Yorkshire Copper Works, Ltd., has changed from its usual venue at Castle Bromwich and occupies a prominent stand at Olympia, where copper, brass and aluminium-brass tubes have been ingeniously used in the construction of the stand itself, 21in diameter copper tubes being used to represent power station chimneys. As well as examples of tubing used for condensers, busbars, etc., rectangular section hollow copper bars are on view, made up to show hollow conductor assemblies for alternator windings, with internal air cooling.

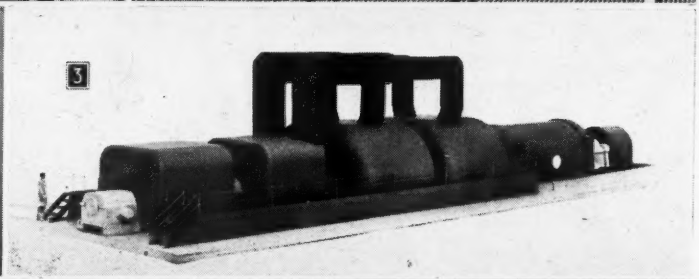
Among the new items on view is a Class AL6 switchgear unit introduced by the B.T.H. Co., Ltd. This is an air-break truck-type metal enclosed switch and represents an increase of the short circuit rating of B.T.H. 3·3 kV air-break gear up to 250 MVA. In addition to the larger size the equipment incorporates a selector switch to give improved circuit isolation and earthing facilities, and a completely flush front appearance is obtained with a full width door on the front of the housing. Standard ratings range from 800 to 2,400 A and flush type instruments and control switches can be mounted on the front door of the housing. The breaker has contacts of the high-pressure butt pattern with silver facing, and designed with a heel and toe action so that current carrying and arcing duties are effectively accomplished in the one structure. Another item on this stand is the RMS 3 marine radar, an improvement on the earlier RM 2, with considerable reductions in size of component equipment.

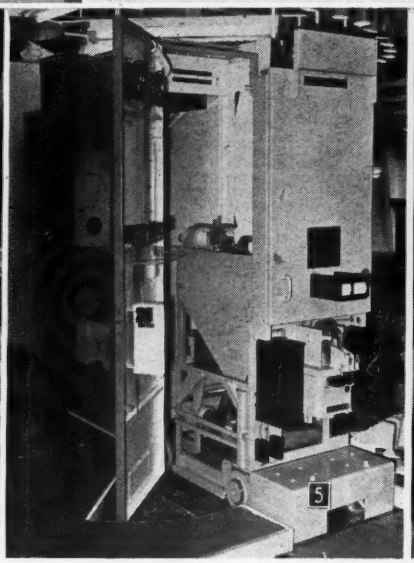
A new design of large flameproof motors has been

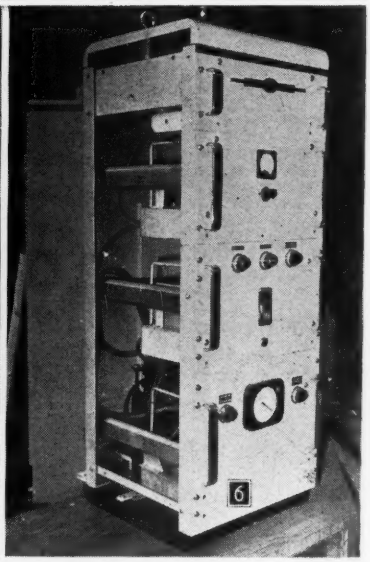




(1) G.E.C. 200 h.p. traction motor and (2) 60 MW l.p. turbine rotor set beside a 325 kW marine auxiliary turbine rotor. (3) 200 MW turbo-alternator outline model shown by C. A. Parsons & Co., Ltd. (4) A Metropolitan-Vickers dual-motor drive for ring spinning in the textile industry. (5) B.T.H. Class AL6 switchgear unit. (6) Servo-controlled contactorless reversing drive panel on the stand of the Electric Construction Co., Ltd.







brought out by Bruce Peebles & Co., Ltd., suitable for such things as oil refinery duty. These incorporate built-in air-to-air cooling tubes and the bearings and air intake fan are situated outside the flameproof enclosure; they are available in sizes up to 690 h.p. and for voltages up to 6·6 kV. These motors seem to be of exceptionally robust construction and are the product of original thought rather than an adaptation of existing designs. Among the other items on this stand is a distribution transformer using cold-rolled grain-orientated steel. Most of the well-known transformer makers now have these available and Ferranti, Ltd., also show one on their stand.

Among the several pieces of equipment on the stand of the Electric Construction Company, Ltd., are a small germanium rectifier unit and an interesting contactor-less reversing drive intended to operate in conjunction with large induction regulators to form a highly accurate regulating system which can be used to control the output voltage of large mercury-arc rectifier installations to within an accuracy of better than $\pm 0{\cdot}2$ per cent. The control unit embodies an error-comparator, a servo-amplifier, a power supply unit and a thyratron output unit which may be used to replace an amplidyne generator. The output capacity of the unit shown is 1·8 kW.

Steam turbines are represented physically by the l.p. rotor of a 60,000 kW turbine, on the G.E.C. stand, and the h.p. rotor of a similarly sized machine, on the stand of C. A. Parsons & Co. Ltd. The latter company also has a model of a 200 MW turbo-alternator design with a sectional arrangement drawing to show the construction. The General Electric Co. also has a new gate-end panel for mining use for squirrel cage motors up to 80 A at 650 V, and a variety of domestic equipment on view. Another item here is a 200 h.p. axle-hung traction motor as being supplied for the Southend extension of the electrified Liverpool Street-Shenfield line. A traction motor is also to be seen on the Metropolitan-Vickers stand.

Reyrolle's have a striking exhibit in the form of a single-phase unit of a 300 kV 7,500 MVA air-blast breaker. This consists of six air-blast turbulators connected in series with an isomaker which provides the necessary clearance across the circuit-breaker in the open position. A sectioned turbulator head can be seen.

CASTLE BROMWICH

THE number of electrical exhibits at Castle Bromwich is this year naturally smaller. What there is, however, illustrates what the electrical industry can do to help other industries perform their tasks more easily and efficiently. Increasing productivity is more often than not the reason for performing a function electrically and a large proportion of the exhibits come into this category.

For instance, the British Electrical Development Association shows how, in the woodworking industry, electrical equipment can be used to remove bottlenecks and increase production at a higher standard and lower cost. This theme from plant layout to materials handling, is emphasised by working equipment, films, and an animated display. In another industry, Foundry Equipment, Ltd., is showing its electrically heated type SP10 shell moulding machine, together with a variety of other items for use in the mechanised foundry. The main item on the stand of Electromagnets, Ltd., is the "Boxmag" selector load system of lifting magnet control, which is most useful for cupola charging in the foundry trade; the operator is in complete charge of the magnet, allowing him to load and unload a definite quantity of material. There is also a portable foundry sand separator designed for the smaller jobbing foundry.

In connection with materials handling, Conveyancer Fork Trucks, Ltd., show their new E2-20 fork truck, which is a three-wheel battery-electric model of 2,000 lb capacity at 20in load centre. It is driven and steered by the single rear wheel, the traction motor being mounted vertically over the rear wheel. This vehicle is extremely manœuvrable and is equipped with means of controlled acceleration and dynamic braking. Amongst a wide range of battery-electric trucks on the stand of Lansing Bagnall, Ltd., is the SFR225 stand-on reach fork truck. Retraction of the complete mast and fork assembly, with the load, inside the wheelbase for travelling and manœuvring, enables this truck to handle 40in by 40in pallets in aisles no wider than 5ft 6in, and 2,500 lb loads can be lifted and stacked to a height of 10ft. Ease of handling has been sought in the new control layout, which incorporates a direction indicator dial in the centre of the one-hand steering wheel. Various battery-electric vehicles are also shown by Ransomes, Sims & Jefferies, Ltd., and these include a tractor capable of hauling trailers of up to 22,000 lb gross load on level concrete floors. It is contactor controlled, has a clutchless drive and embodies all the rugged features of the company's fork lift drive. It has pneumatic tyres for uneven surfaces but it can also be supplied on a cushion of solid tyres.

During the last year or so gas turbines have been increasingly used as prime movers for electrical generating plant. An interesting range of gas turbine generating sets is shown by the Rover Co., Ltd., having outputs of 30 kVA at 400 c/s, 40 kVA at 400 c/s, and 50 kVA at 50 c/s. There is also a gas turbine driven fire-fighting set with an output of 500 gal/min. A varied range of engine-driven electric generating plants with capacities ranging from 300 W to 100 kVA is displayed by A. C. Morrison (Engineers), Ltd., together with diesel welding sets with outputs of from 150 to 400 A. The electrical exhibits of C.A.V., Ltd., include generators and engine starters. Among the generators are 5in and 7in dia. models, one type being fireproof, while the starters include the 6in diameter "Axial" type, which is suitable for starting marine, transport and heavy industrial engines. In a connected field Joseph Lucas, Ltd., have the "Beam-setter" which has been designed to enable any garage mechanic, without specialised knowledge of lighting technique, to set headlamps accurately, making allowances for vehicles not carrying their normal full load or a full complement of passengers. This should be particularly useful as the Slough experiment, planned in association with the Ministry of Transport and the Road Research Laboratory, proved that 75 per cent of the cars examined had badly set headlamps.

Heating is of major importance in all industries and G.W.B. Furnaces, Ltd., have on view the largest and smallest in their range of "Powermaster" packaged oil/gas fired boilers with outputs of 17,250 lb and 517 lb of steam per hour respectively. Both of these boilers are completely self-contained automatic units for raising steam up to 250 lb/sq in and for water heating.

In the field of electro-deposition the main exhibit of W. Canning & Co., Ltd., is a bright nickel plating installation, which consists of a vat complete with rods and connections together with filter unit and heat exchanger direct coupled forming a complete unit ready for operation. A feature of the installation is the heat exchanger, which enables steam or high-pressure hot water to be passed through the unit whereby heat is extracted and transferred to the plating solution which passes through the exchanger in a contra-flow direction. Thus a high rate of heat input is given to the solution. The range of heat exchangers available covers models for use with tanks from 300 gal

up to 2,500 gal capacity. In a similar field Fescol, Ltd., show the latest developments in the direct deposition of hard chromium on to any of the known light alloys. The exhibit illustrates the wide capacity of the company's plants, which are capable of dealing with components up to 20ft long and six tons in weight.

Electric motors are now used in such large numbers in all industries and for such widely differing duties that they are considered as standard items of equipment. It is only during the last year or so, however, that any real effort at standardisation has been made between the British motor manufacturers. This point is illustrated by Brook Motors, Ltd., who are showing their range of British Standard motors as well as a new automatic push-button starter for motors of up to 0·5 h.p. It is of simple construction, incorporating plastic mouldings, die castings and sheet metal pressings. There are also the new "Merlin" f.h.p. motors, which have been designed for use in domestic appliances of all kinds, and a range of shaded pole machines. The latest model shown by Fractional H.P. Motors, Ltd., is the C.70 geared motor, which is available with various standard output speeds ranging from 0·125 r.p.m. to 12 r.p.m. and with torques up to 250 lb/in. An interesting range of geared motor units is also displayed by the Moss Gear Co., Ltd., while E. C. Hopkins, Ltd., are demonstrating flexible shaft machines. Shaft mounted speed reducers were relatively unknown in this country until the "Torque-Arm" was introduced by J. H. Fenner & Co., Ltd., last year. The success of the first four sizes has created a demand for higher powered units and two larger ones are shown on the stand.

The exhibit of Keith Blackman, Ltd., includes a special display of fume removal fans all with solid, rigid p.v.c. casings and impellers. There is a 10in bifurcated fan in which the motor is protected from attack by chemical fumes, and the Series I open paddle bladed fan with a 12in impeller which is representative of a range handling from 50 cu ft/min to 2,500 cu ft/min. There is also the

(1) Electrical heating equipment for the woodworking industry shown on the E.D.A. stand. (2) Foundry Equipment SP 10 two-station shell moulding machine. (3) G.W.B. "Powermaster" oil/gas packaged boiler. (4) Brook "Merlin" f.h.p. motor (right) and shaded pole machine (left). (5) Lansing Bagnall stand-on reach forktruck. (6) Canning bright nickel plating installation. (7) Lucas "Beamsetter." (8) Rapid Magnetic Machines laboratory mineral separator. (9) Electromagnets portable foundry sand separator

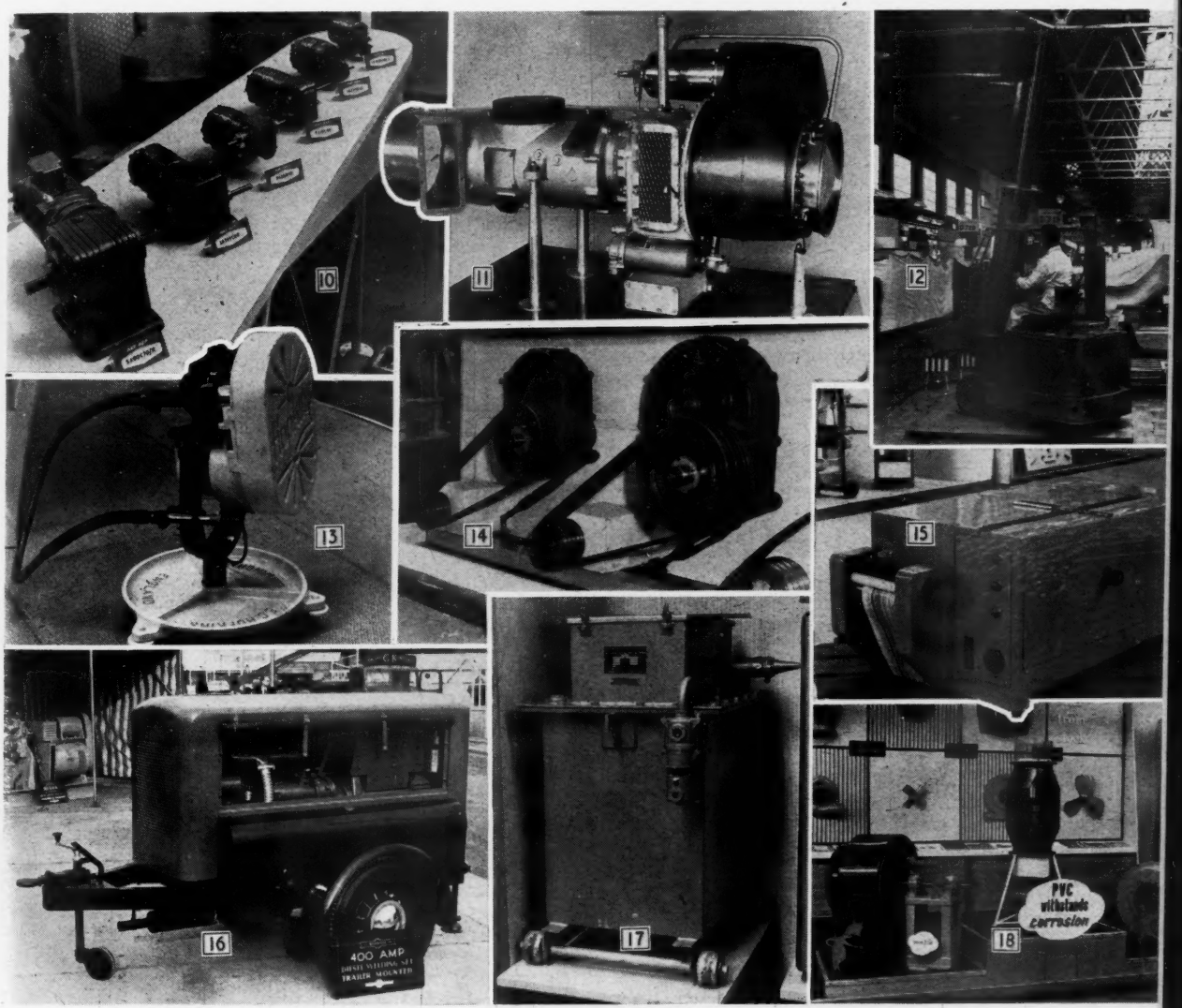
Series II multi-vane centrifugal fan from the range with impellers from 15in to 42in diameter and duties of from 2,000 to 40,000 cu ft/min at pressures up to 40in water gauge.

The range of DZT pumps made by the British LaBour Pump Co., Ltd., has been designed with a view to improving efficiency in chemical liquor pumping applications. A tapered open-type impeller is used so that a smaller pump using less h.p. will carry out duties hitherto requiring larger and more expensive types of pumps. These pumps can run at speeds up to 3,300 r.p.m. The continued demand for mineral separating equipment has prompted the exhibition, by Rapid Magnetic Machines, Ltd., of their laboratory type O machine, which is the research version of the model OG separator that is used in many industries.

Instruments are becoming more necessary with the increasing mechanisation of industry and a representative selection of electronic devices for industrial use is shown by Fielden Electronics, Ltd. There are electronic instruments for the indication, recording and control of process variables and laboratory instruments for light current and voltage recording, etc. In a similar connection Southern Instruments, Ltd., have a comprehensive display of electronic equipment. An interesting piece of equipment here is the type M732C auto-developer, which is designed for processing oscillograph records under daylight conditions without a dark room. It will develop, fix and dry any width of photographic paper up to 150 mm in lengths up to 200ft on one charge of solutions.

In a different field altogether Fawcett Finney, Ltd., have on their stand the complete machinery, with full automatic control, for extruding plastic covering on to wires at speeds up to 2,500 ft/min and winding the finished insulated wire or cable on to drums at the same speed. The Westinghouse Brake & Signal Co., Ltd., shows a number of new equipments including a cathodic protection rectifier unit rated at 6 V, 150 A continuously at 25 deg C.

(10) "Fracmo" C70 geared motors. (11) Rover 30 kVA 400 c/s gas-turbine generator. (12) Conveyancer E2-20 forktruck. (13) Hopkins flexible shaft machine unit. (14) Fenner "Torque-Arm" shaft mounted speed reducers. (15) Southern Instruments auto-developer. (16) Morrison welding generator set. (17) Westinghouse cathodic projection rectifier. (18) Keith, Blackman fans for handling corrosive fumes



ANNUAL MEETING OF THE B.E.A.M.A.

LAST week we gave a summary of the 1955-56 report of the British Electrical and Allied Manufacturers' Association. Commenting on the report at the annual general meeting on 19th April, Mr. E. H. Ball, chairman of the Council, said that the industry had reached a new high level of exports of £245 million, an increase of 12 per cent over the previous year, despite increasingly severe foreign competition and in the face of balance of payment difficulties, discriminatory tariffs and rising costs.

Running through the report there was a significant theme of increasing Government interference with the freedom of the industry which was surprising in view of the Government's declared policy of "setting the people free." The Government was by far the greatest beneficiary from the profits and wages of the industry. The tax content in the cost of products was the major handicap they had to overcome in meeting foreign competition. Tax was the national overhead which industry had to recover, and it was therefore alarming to read of pending reductions in taxation by the government of our chief competitor, since this must inevitably result in lower national overheads for that competitor.

In addition, it seemed ironical that the two greatest exporting industries, road vehicles and electrical equipment, should be singled out for special handicap by the Government. Mr. Ball referred to the Monopolies Commission, the Herbert Committee Report (which recommended their chief customer to obtain foreign tenders, whilst the Government provided no protection against dumping, the legislation having been deferred), the Restrictive Trade Practices Bill, purchase tax, credit and capital squeeze, and last, but perhaps not least, the withdrawal of support from the British Industries Fair. These things created an air of uncertainty and diverted the attention and much of the energy of directors and senior staff from their proper tasks of administration and from the sale of their products overseas by more frequent commercial travelling.

They were exhorted to re-double their efforts to increase exports, but the Government seemed to have decided that free people could not be trusted to expend their own money and resources wisely. Even the best and most loyal workman eventually ceased to respond to repeated exhortation to produce more and required some incentive other than a sense of duty. They were doing everything within their power to combat the measures which were designed to restrict their freedom to co-operate for the orderly manufacture and distribution of their products, and to avoid resort to jungle warfare which could have disastrous results for the Exchequer.

On the credit side of the account Government policy to speed the development of nuclear power and the electrification of the railways was commendable, as also was the White Paper on technical education which showed a determination to tackle the vital problem of providing future engineers and technicians. Progress had been made by the Industrial Fund for the Advancement of Scientific Education in Schools, to which members of industries had made very substantial contributions now exceeding £3 million.

IMPULSE STRENGTH OF DIELECTRICS

AT a meeting of the Supply Section of the Institution of Electrical Engineers in London on 25th April three papers were presented dealing with the impulse strength of various types of dielectrics.

In the first paper, by Messrs. H. C. Hall and E. Kelk (both of British Insulated Callender's Cables, Ltd.), it is shown that the impulse strength of oil-impregnated paper, measured on single sheets, is related to the impulse strength of lapped dielectric using the same paper. The authors show that while for the greatest impulse strength of a single sheet of paper it is best, if one property only is to be specified, to choose a paper with as high an apparent density as possible, it is nevertheless considerably better to specify the paper in terms of a high impermeability and, at the same time, a high degree of uniformity. Although this is demonstrated in the paper for uniformity of surface profile it might be expected, in view of the photographic evidence that electrical failure is associated with the more transparent areas of the paper, that some measure of uniformity of transparency would be even more useful in specifying electrical quality.

In the second paper, by Messrs. H. C. Hall and D. J. Skipper (also of British Insulated Callender's Cables, Ltd.), a description is given of an investigation of the impulse strength of lapped impregnated paper dielectric which has been made using model cables. The subjects studied include the effects of variation in the physical properties of the paper and the impregnant, the effects of variations in construction of the dielectric, and the effects of temperature and pressure. In addition, the response to different test procedures, such as polarity, polarity reversal and reheated stressing, is examined. The authors conclude that the impulse failure of a lapped dielectric is initiated at or in the region of the butt spaces, probably at the radial oil/paper interface, and may possibly be considered as a two-phase process, failure of the butt gap (by itself not necessarily leading to complete breakdown), and failure of the impregnated paper in series with the butt gap. Both phases influence the level at which complete failure takes place.

In the final paper, by Messrs. W. G. Standring and R. C. Hughes (both of the National Physical Laboratory), the progress of an investigation of the breakdown of solid and liquid dielectrics in combination is described, and generalisations are made about the effects of electrode shape, impulse duration and polarity on the puncture voltage of alternate layers of solid and liquid, and on the flashover voltage of a solid and liquid interface under conditions of stress. With some geometrical arrangements of solid and liquid dielectrics in combination it seems possible to make a degree of generalisation about breakdown which may be of help to designers of high-voltage equipment. It would be impracticable to provide data for arrangements of all possible shapes and sizes, but information of the type given in the paper may reduce the work necessary for the development of new designs, either by eliminating the need to consider some variables, by indicating qualitative preferences, or by suggesting more convenient forms of suitable test sample than an actual model of the proposed system.

Russian Power Supply

PROGRESS DESCRIBED IN ADDRESS TO BRITISH M.P.s

MR. G. M. MALENKOV, Minister of Power Stations of the U.S.S.R., addressed a gathering of Members of Parliament in the House of Commons on 28th March on "The Soviet Power Industry." He said that Russia produced a mere 2,000 million kWh in 1913, and took a place as low as fifteenth in the nations of the world in regard to electricity output. In 1940 the output was 48,000 million kWh; in 1950 more than 90,000 million kWh; and in 1955 170,000 million kWh.

The Soviet Union had considerably surpassed all the economically advanced countries, with the exception of the U.S.A. In spite of this rapid development, however, a number of regions of the country still experienced a shortage of plant, with the result that the development of the economy of these regions was being retarded. Russia's plans envisaged the further rapid construction of thermal and hydro-electric power plants, so that the installed capacity of power stations should be more than doubled during 1956-60, and output of electricity should be raised to 320,000 million kWh by 1960. Hydro-electric stations with an aggregate capacity of more than 20 million kW were to be built during the current five-year period and the output of the hydro-electric stations in 1960 would be 2·6 times as great as it was in 1955.

Large-Scale Hydro-Electric Developments

After the war Russia set about the construction of the immense Volga hydro-electric schemes, the Kuibyshev and Stalingrad stations, each with a capacity of over 2 million kW. These stations would have a total annual output of more than 22,000 million kWh. The first units at Kuibyshev, of 105,000 kW capacity each, were already producing power, and the time was not far distant when the first units of the Stalingrad station would go into operation. Last year, on the Volga, the 400,000 kW Gorky hydro-electric station was commissioned and the construction of the 1,000,000 kW Saratov hydro-electric station was begun; construction would be started very shortly of the 800,000 kW Cheboksary hydro-electric station. It was planned to build a powerful hydro-electric station in the Volga estuary—the Lower Volga station. Thus, together with the stations previously built on the Volga—Ivankovo, Uglich and Rybinsk—there would be a chain of stations which would ensure an output of more than 40,000 million kWh a year.

A second hydro-electric station, Kakhovka, had been commissioned on the Dnieper; construction of a third station, Kremenchug, had been started and later two more large stations, Dnieprodzerzhinsk and Kanev, were to be built. In the Urals, the hydro-electric station on the River Kama, near the town of Molotov had gone into operation, construction of a second station, the Votkinsk, had been started and work was later to be started on a station at the mouth of the River Kama, the Lower Kama station, with a capacity of about a million kW.

With the construction of these stations, the hydro-power reserves of the big rivers in the European part of the U.S.S.R. would in the main have been exhausted.

It was planned to build on the River Angara a chain of hydro-electric stations with a total capacity of over 10 million kW and an annual output of more than 70,000 million kWh. The Irkutsk hydro-electric station, the first of this chain, would come into operation this year. Construction had been started of a second station on the Angara, the 3,200,000 kW Bratsk station, having 16 sets of 200,000 kW each. Similarly, on the River Yenisei a chain of stations was to be built with a total capacity of about 20 million kW and with an annual output of over 130,000 million kWh. Near Krasnoyarsk on the River Yenisei, work was now proceeding on a hydro-electric station with a capacity of more than 3,000,000 kW.

Advanced Steam Conditions

In spite of the enormous scope of hydro-electric construction, the building of fuel-burning stations was by no means unimportant. Already since the war several stations of 500,000-600,000 kW capacity each had been built, but now they were building larger stations, of 900,000 to 1,200,000 kW capacity, having turbo-alternator sets of 100,000, 150,000, 200,000 and even 300,000 kW installed for unit operation, i.e. one boiler per turbine. The plants to be installed at the new thermal stations would have steam pressures and temperature of the order of 2,000 lb/sq in and 1,050 deg F, 3,200 lb/sq in and 1,110 deg F and 4,000 lb/sq in and 1,200 deg F.

Very many thermal stations were being built with a view to utilising exhaust steam from the turbines for the centralised district heating of industrial enterprises and towns. Mainly local fuels were used in the Soviet power industry—brown coals, peat, anthracite chips, coal-enriching by-products, and shales. The power industry had been given the task of mastering the burning of coals with ash content up to 45 per cent and moisture content up to 50 per cent.

In the current five-year period, i.e. by 1960, construction would be completed of a number of atomic power stations with a total capacity of 2½ million kW, and using various types of reactors. Calculations showed that capital expenditure on the construction of atomic electric stations would be somewhat higher than that on conventional thermal electric stations of similar capacities. However, the production costs of the electricity generated would be lower than those of coal-fired stations.

Transmission at 400 kV

A most important feature of the technical policy for the electrification of the U.S.S.R. was the development of power grids and the unification of power systems. By the consistent unification of relatively small power systems, three big grids had been created—one in the central part of the Soviet Union, another in the south, and one in the Urals. Extensive work was now being advanced to create a unified European power system covering the power stations of the central area, the Urals and the south, including the Donetz Basin, and several other industrial districts. With this in view, construction was being completed shortly of a 400 kV transmission line, over 800 km long (roughly 500 miles), linking the Kuibyshev hydro-electric station with the Moscow power system.

Other 400 kV transmission lines to be built would link the Kuibyshev station with the Urals, and the Stalingrad station with the Moscom power system. Further, the Stalingrad station would be linked with the Don Basin power system by a 400 kV d.c. transmission line.

Laboratory Precision Devices

Indirectly Heated Thermistor and Permittivity Measurement Bridge

TWO papers were given before the Measurement and Control Section of the Institution of Electrical Engineers on 17th April. The first, by Mr. F. C. Widdis (Northampton Polytechnic), concerned the use of an indirectly heated thermistor as a precise a.c./d.c. transfer device over a wide range of frequency (down to 0·2 c/s) with an error well within $\pm 2\frac{1}{2}$ parts in 10,000. By the elimination of thermal drift a high degree of thermal stability had been obtained. Experiments on the reproducibility of the thermistor indicated complete absence of hysteresis over the working range. The high sensitivity of the device, which enabled a relatively insensitive galvanometer to be used as a detector, was somewhat outweighed by its slow response, which might be troublesome at high frequencies, but constructional modifications suggested in the paper would improve response at power frequencies and over, though with some loss in the low-frequency range.

In the second paper Mr. A. M. Thompson (Commonwealth Scientific and Industrial Research Organisation, Australia) described a null method for the measurement of the complex permittivity of dielectrics. In the bridge network employed the direct admittance of a three-terminal capacitor with the sample as dielectric was measured as a complex capacitance, the two components being indicated directly on two three-terminal variable capacitors. The bridge network also comprised transformer ratio arms and an amplifier whose output voltage was in quadrature with that of the transformer. The bridge operated at ten fixed frequencies from 30 to 10^6 rad/sec.

DISCUSSION

Opening the discussion, Dr. A. H. M. Arnold (King's College, London) said that he himself would credit the thermistor with greater accuracy than $2\frac{1}{2}$ parts in 10,000. It was his own impression that it was good to about 1 part in 10,000 and there was nothing to suggest a greater error in Mr. Widdis's paper except the final test of the thermistor against the thermocouple. While he himself thought the thermistor might prove very valuable as an a.c. transfer device, he shuddered to think of its being used to assist in using an a.c. potentiometer. The middle frequency range was, he thought, adequately covered by the dynamometer and the electrostatic voltmeter, and there were three possible uses for the thermistor. The first was to check the dynamometer and the electrostatic voltmeter. The second was to provide a transfer device in the frequency ranges where those instruments could not be used; that was to say, the lower frequency range. At the higher ranges, he was not convinced that it could hold its own against the thermocouple. The third was to calibrate the thermocouple.

Dr. C. J. N. Candy said the high degree of stability obtained by Mr. Widdis for the thermistor circuits was very encouraging. It would seem that once the difficulty of drift with ambient temperature had been overcome, the thermistor was a very useful circuit element. He himself had used the indirectly heated thermistor in a slightly different application, overcoming the difficulty of non-linearity and thermal drift by employing two thermistors.

The process of heating the thermistor in an oil bath, referred to in the paper, could be avoided by making measurements on the voltage current characteristic alone.

Mr. A. Felton (National Physical Laboratory) said it was a good thing the thermistor was not developed ten years ago, because it would have been rejected instantly as a transfer device on account of its long time-constant. It would be awkward to use on a rotated generator or unstabilized electronic supply, and its success really depended on the simultaneous development of stabilised oscillators. The paper was a model of what it should be and would, he felt sure, be the classic on thermistors. These would be used more and more for measurement. He thought, however, that in his enthusiasm for the new Mr. Widdis had done less than justice to the old. He must entirely repudiate the suggestion that the voltmeter and its accessories were elaborate and only useful in a national laboratory. On the contrary, they were exceedingly simple and entirely suitable even for a commercial laboratory.

Aid to Dielectric Research

Dr. L. Hartshorn (National Physical Laboratory), who opened the discussion on Mr. Thompson's paper, asked whether there was any prospect of pushing the technique to higher accuracy. The instrument described was clearly a convenient research tool for work on dielectrics. The ingenious device of measuring the conductance in terms of the equivalent capacitive admittance energised by the quadrature amplifier secured a great advantage in resonance apparatus for work in the high frequency region. The range covered was of great importance where a big range had to be covered in order to acquire certain information.

He and Ward had achieved that condition years ago, but its extension to the 5 c/s and 160 kc/s range was a most important contribution to dielectrics. He wished the instrument could be supplied to physical chemists who made a great number of measurements on dielectrics and were much given to the use of resonance circuits of very high sensitivity. No doubt they would say their sensitivity was one in a million and it would not be much use telling them they could do with less sensitivity. But they could get all they wanted with Mr. Thompson's accuracy because to get a true balance adjustment sensitivity of the order of 1 in 10,000 was wanted, and by substitution procedure they could get it. It would be well to remind them that there was a second component of the vector associated with their dielectric constant that should be taken into account. There might be some future in Mr. Thompson's bridge as a commercial instrument in testing to specifications, but on the whole the structure would be rather elaborate.

Mr. J. K. Webb (Standard Telephones Research Laboratories) described a device using thermistors made in his laboratories to solve the problem of measuring the r.m.s. value of a complex waveform. Mr. Thompson's paper was a model of clear presentation, he said, with two small reservations. There was no reason why he should inflict angular frequencies on anyone and give them the mental effort of dividing by 2π. Secondly, he had been brought up in the tan δ school and would have liked the figure to be worked out for him.

Mr. C. G. Garton (Electrical Research Association) said that the Schering bridge was all very well in the most favourable frequency range for its use, but it had one or two fundamental defects. First, two of its arms were resistive and two capacitive. This meant that stray mutual inductance between arms appeared as a quadrature error. Secondly, complete screening was complicated. Thirdly, when it was used for great sensitivity the loss angle correction could be made only at one frequency. For sensitive work many filters and heterodyne methods were required to remove the harmonic response. The feedback arrangement was an obvious advantage of Mr. Thompson's bridge. He thought the all-capacitor type of bridge with balanced ratio-arms was on the correct lines. There were many alternatives to the one published in the paper, and provided a substitution method was used, it was not even essential to have closely coupled ratio-arms. It was sufficiently good if the middle point was not appreciably displaced.

PARLIAMENTARY REPORT

IN the House of Commons last week Mr. Moss asked the Lord Privy Seal what steps were being taken to secure contracts to build nuclear power stations in Australia.

Mr. Butler said that responsibility for securing contracts for the supply of nuclear power stations to overseas countries would rest with the companies who were able to supply them. A number of British companies were engaged in designing nuclear power stations in conjunction with the Atomic Energy Authority and the electricity authorities in this country, and this should enable them to undertake export orders in due course.

Mr. Moss said that American propaganda in Australia was stigmatising British achievements in the nuclear field as obsolete and asked what action was being taken to counter this propaganda.

Mr. Butler said he would be glad to study any information on this subject but the third report of the Australian Atomic Energy Commission indicated that there would be an opportunity for the kind of British exports which Mr. Moss had in mind.

Mr. Palmer asked the Lord Privy Seal by what principle particular private industrial firms were selected to collaborate with the Atomic Energy Authority in nuclear energy development for commercial and export purposes.

Mr. Butler said the Authority, in normal circumstances, followed the standard Government practice of placing its contracts by tender. Where special circumstances made competitive tender procedure impracticable, or where forms of collaboration otherwise than by contract were involved, firms were selected according to the resources of experience and skilled manpower which they were prepared to devote to their work.

Mr. Moss asked what progress had been made in making available a supply of enriched fuel for use in prototype nuclear reactors of medium size designed specially for export purposes.

Mr. Butler said the development of this type of reactor had not yet reached a sufficiently advanced stage for a prototype to be built. The question of supply of enriched fuel therefore did not arise.

Asked whether he would consider the publication of a White Paper on "Nuclear Power and the Export Trade," Mr. Butler said he would discuss this with the Lord President of the Council, but it would be premature to take the action proposed by Mr. Moss.

Mr. Callaghan suggested that the Government should consider transferring the scientists and technologists now engaged on defence requirements into the field of peaceful uses of atomic energy, thus making it possible to speed up the building of the power stations and the supply of enriched fuel for them.

Mr. Butler said he would certainly discuss this with the Lord President.

In reply to a further question, Mr. Butler said the exchange of information on atomic energy matters between the United States and the United Kingdom was governed by two agreements signed in June, 1955. Co-operation under these agreements was proceeding smoothly.

New I.T.A. Station

Dr. Hill, the Postmaster-General, informed Mr. W. R. Williams that the Independent Television Authority's Lancashire station was to be opened early in May. The exact date would be announced shortly.

Anglo-Japanese Trade

Mr. Low, Minister of State, Board of Trade, told Mr. Bottomley that the mid-term review of the Anglo-Japanese trade arrangements made last October had been concluded. It was decided that the arrangements were working satisfactorily and that no change was necessary. Provision was being made for additional trade over the next six months amounting to about £150,000 each way. The new quotas secured for our exports covered chemical products, manufactured foodstuffs and light engineering goods.

Agreement on Export Policy

Mr. Bottomley asked the President of the Board of Trade how far the agreement to abolish artificial aids to exports had now been carried out by member countries of the Organisation for European Economic Co-operation.

Mr. Low said the reports submitted by those countries to which the Organisation's agreement applied were being studied within the Organisation. Of the other member countries, Greece and Turkey were exempt from the agreement. In the case of France, it was agreed that a date should be fixed after which she would be bound by the Organisation's agreement to discontinue artificial aids to exporters. It had not yet been possible to agree a date. Meanwhile, the Government would continue to impress upon the French Government their concern that all her artificial aids to exporters should cease.

Licences for Exports to China

Mr. Snow asked the President of the Board of Trade whether he would take steps to ensure that British companies were not frustrated in competing with Japanese companies by the lengthy consideration of applications for licences to export to China goods on the permitted list or goods which might be the subject of quantitative controls.

Mr. Low: There is no quantitative control list for China. Licences for goods on the permitted list are issued within about two days of the receipt of the application, apart from exceptional cases where the information available is insufficient to establish the facts readily.

Exports to Indonesia

Mr. Low informed Miss Vickers that the export of capital goods to Indonesia was not restricted. United Kingdom exports to Indonesia last year amounted to £11·2 million, of which about one-third were capital goods.

Employment of Foreign Scientists

Mr. Callaghan asked the Minister of Labour what was his policy about the employment of foreign scientists and technologists in research and industry in this country.

Mr. Macleod said his Department granted permits, subject to the usual conditions, to employers desiring to engage foreign scientists and technologists in all branches of science and engineering in which there was a serious shortage of qualified British subjects.

Rating of Industrial Premises

The Private Member's Bill to end industrial de-rating was approved by a committee of the House of Commons after the operative Clause had been passed by 18 votes to 17. It will now come before the whole House for report and third reading.

Ex-Company Pensioners

Mr. David Renton, Parliamentary Secretary, said the Minister of Fuel and Power had approved in principle proposals submitted by the C.E.A. and Area Boards for increasing the pensions of ex-company pensioners.

Technical Manpower

Mr. Albu asked the Minister of Labour what were the terms of reference and composition of the committee which was investigating the supply and utilisation of scientific and technical manpower.

Mr. Macleod replied that this inquiry was being undertaken by the Social Survey on behalf of his Ministry and the Department of Scientific and Industrial Research. The results would be considered by his Technical Personnel Committee and by the Committee on Scientific Manpower of the Advisory Council on Scientific Policy, which would report to the Lord President of the Council. The inquiry was into the numbers and distribution of scientists and engineers.

Debate on Budget Proposals

THE changes in the method of financing the nationalised industries announced by Mr. Harold Macmillan during his Budget speech were commented upon by many M.P.s in the four-day debate which followed.

Mr. Hugh Gaitskell, Leader of the Opposition, speaking immediately after the Chancellor, did not see any objection to what the Government proposed for the nationalised industries. Certainly, if it gave the Government a greater assurance that the level of investment in the nationalised industries could be exactly what the Government wished it to be, he did not think the Opposition could raise any objection.

Squadron Leader A. E. Cooper was disappointed that the Chancellor had made no reference to the coal industry because the plain fact was that it had let the country down. It was the one industry which had shown no increase in productivity since the war notwithstanding the vast sums poured into it for re-equipment.

Many members were appalled when they heard the Chancellor say that £510 million was now brought in by purchase tax. This could only have a distorting effect on industry and it could be shown clearly that this tax was one of the factors limiting the possibilities of increased exports. It should be abolished and replaced by a general sales tax.

Mr. Chetwynd suggested that unconventional means should be used to stimulate exports, such as linking export performance with the incidence of purchase tax at home. For every £1,000 worth of goods exported overseas, the manufacturers should be allowed to sell the equivalent value on the home market free of purchase tax. His argument was that consumers would naturally be encouraged to buy the cheaper articles at home, and this would stimulate the manufacturer to increase his exports.

Brigadier Prior-Palmer contended that we were losing markets because goods were not delivered on the dates promised and because prices were too high. People on the management side of industry were also not working in the way their counterparts in Germany did.

Mr. Idwal Jones said that Germany had recovered because she had concentrated upon capital investment; we had gone down because we had cut it.

Mr. Harold Wilson recalled that Mr. Butler in 1954 introduced investment allowances and exhorted everyone to "Invest in Success," but in 1955, when industry belatedly responded to the request, the Government panicked and ran away. Their effort to restrain investment was retrograde and shortsighted.

Prosperous Conditions

Mr. Peter Thorneycroft, President of the Board of Trade, said that, putting aside statistics, there were signs of unexampled prosperity in almost every quarter. Employment was booming and all could take pride in the new houses that had been built and in the new devices in the houses—automatic washing machines, television sets and refrigerators which had been bought in recent years. There were two problems which marred the beauty of the scene; one that we had been expanding a little faster than resources permitted, and that the rather ill-defined middle classes had suffered perhaps more than any other class by the process of inflation. But the Government could not do a lot to help these people until they had solved, or gone a long way towards solving, the problem of inflation itself.

Hire purchase figures dealing with household goods showed that since October, month by month, there had been a steady fall in transactions, but he must warn the House that October was an artificially high month. There was some easing in the labour situation but there was no sign yet of a marked switch into the industries which were particularly short of labour.

Mr. Tom Brown challenged Squadron Leader Cooper on his statement about the coal industry. In fact, since vesting day, there had been a gradual and continual increase in output, he said. Output per man shift had increased from 2·85 tons in 1947 to 3·25 tons in 1954.

Mr. C. R. Hobson said the nationalised industries had been adversely affected by the high interest rates. Rigid control of investment at a low rate of interest would save thousands of pounds not only to the Exchequer but on commodity prices. It had already been stated by the electricity and gas boards that their prices had had to be increased as a direct result of the dear money policy.

He considered Mr. Chetwynd's scheme for stimulating exports by giving purchase tax concessions on the home market was feasible. In a general plan for exports the Government must concentrate on those goods which we made better than any other country—including electrical apparatus, from turbines to electronics—ships, and the products of heavy engineering.

Mr. Grimond welcomed the new means of financing the capital requirements of the nationalised industries. Obviously, he said, the finding by these industries of large sums by short-term borrowing had bedevilled the anti-inflation campaign of the Government. He hoped the Chancellor was sincere when he said it was his intention that at least some of the nationalised industries should finance their capital requirements in the ordinary commercial manner. He did not see why, in the case of electricity, that should not come about reasonably soon. The House should be told more about the effects of the new policy. At present it was not possible to relate the capital accounts of the oil industry to those of other types of fuel and power. He presumed that the new method of finance would also cover atomic energy.

Tenders for Portuguese Contract

Mr. Cyril Osborne said that if industry would go back to the 5½-day week half our economic troubles would be over. The Germans were beating us on quality and price, and M.P.s must get it into the minds of people on both sides of industry that the only way out of trouble was to work more efficiently than in the past. It was reported that the Radio Corporation of America and General Electric of America had submitted lower tenders than Marconi or Pye of Britain for a television transmitting system for Portugal; the bids and delivery times were R.C.A., £398,000 and five months; G.E.A., £433,030 and one to four months; Marconi, £478,865 and 12 to 19 months; and Pye, £556,508 and nine to 18 months. This was reported at a time when we prided ourselves that in the electronics group we beat the world.

Mr. Osborne's greatest regret about the Budget was that it did nothing for the middle-class worker. In the last 20 years the men who ran industry—the professional and managerial types—had come down in the world enormously, he said. When he asked a question recently about electronic engineers who were being offered salaries of £3,500 and £4,500 a year by the Westinghouse Brake Co. of America to do the work which these men did in Britain for £1,400, he had dozens of letters from young scientists telling him that they were drawing only £700 and £800 a year. These men were leaving the country in large numbers and we could not afford it.

FUEL OIL APPLICATIONS

INDUSTRIAL use of fuel oil in the United Kingdom was stated by Mr. T. Chippendale (Shell-Mex & B.P.) in a paper presented to the Institute of Fuel on 4th April to have increased from 1·43 million tons in 1938 to 7·75 million tons in 1955. By 1960 the figure was expected to reach 22 million tons, of which the Central Electricity Authority would require about 6 million. Among the examples given of the application of high-intensity combustion (giving a heat release of at least one million B.Th.U./hr) was one in which six combustors were arranged to fire into an electric arc furnace to pre-melt the metal before it was refined.

INDUSTRIAL NEWS

Contract Price Adjustment Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 14th April is deemed to be 175s. The "cost of materials" figures are:—For electrical machinery and equipment the Board of Trade index figure published on 14th April is 199·6. For turbo-generating and allied plant: Materials used in mechanical engineering industries, 177·1; blast furnaces and iron and steel melting and rolling (40 and 41), 157·0.

N.Z. Power Station Contract

Reuter reports that the New Zealand Government has accepted the tender of a group of American and New Zealand firms to build a power generating station. The tender by the group was the lowest of three submitted for constructing a coal-fired steam-driven generating station at Mercer, 40 miles south of Auckland. The cost of the project, which will have a total output of 180 MW by six turbo-alternators, will be approximately £6 million.

The organisation is formed by Morrison Knudson New Zealand, Ltd., the Morrison Knudson Company Incorporated, U.S.A., and H. K. Ferguson & Company, U.S.A., with Downer & Company, Ltd., New Zealand.

Separate contracts for six boilers have been let to Babcock & Wilcox, Ltd., of the United Kingdom, while contracts for three turbo-alternators each have been let to the English Electric Co., Ltd., and the Metropolitan-Vickers Electrical Co., Ltd. The power station is expected to be in full commission in August, 1959.

British Driver-Harris Conference

The implications of the Government's economic policy were considered at a conference held by the British Driver-Harris Co., Ltd., for three days in the early part of this month. Present were the directors, heads of departments, officials from the works and laboratories, and outside representatives from the company's London, Manchester, Birmingham and Newcastle offices. Mr. R. M. Parry, managing director, said that although as a result of the credit squeeze it appeared that a certain number of those sections of industry using British Driver-Harris materials were being affected (principally in the domestic markets of the electrical appliance and radio/TV fields) the company itself was producing and delivering as much material as ever. Apart from the economic situation the meeting devoted considerable time to discussion and interchange of ideas concerning the research, production and marketing of the company's various products.

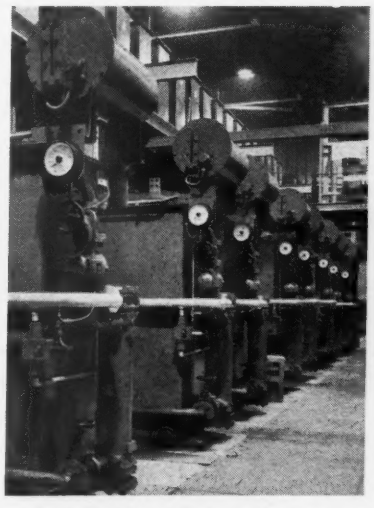
Twin-Town Exhibit

Huddersfield will have a special stand at a trade fair to be held at its twin town of Besançon in France. Local industries, engineering, textiles, dyestuffs, etc., will be displayed together with specimens of local craft work supplied by the Huddersfield Technical College. Brook Motors, Ltd., is sending a specially adapted display unit which will link its products with its French representatives in Paris. The exhibition is open from 5th to 13th May.

Brook Motors display unit which will be shown at the trade fair at Besançon, France

Continuous Production of Titanium

A large rectifier installation designed to feed the new titanium melting furnaces of William Jessop & Sons, Ltd., at Brightside Works, Sheffield, is unique in that it is the first full-scale titanium process plant in Europe which uses power metal rectifiers, and moreover, the first in the world to employ the Westinghouse series-resonant circuit. This offers the advantages of high efficiency combined with a wide range of output characteristics to give voltage/current gradients at the load operating point extending from $-\frac{1}{80}$ to $-\frac{1}{4}$. As an essential feature of the melting process is to preserve the operating point gradient, the plant has current control at a constant voltage. The current range is from 0 to 18,000 A and this holds for any selected voltage between 0 and 40 V.



Westinghouse rectifier installation for the titanium production unit of William Jessop

The equipment is rated to work continuously. The "Westalite" rectifier assemblies are forced oil-water-cooled with the transformers oil-immersed and naturally air-cooled. Switchgear and other auxiliary circuit components are air-cooled to be in accordance with the site layout and special processing technique. The control panel is arranged so that each furnace operator has the full range of controls immediately around him, but is not distracted by any other operator nor can his use of power interfere with their work.

Lifts at Bucklersbury House

The lift installation at Bucklersbury House, London's largest and tallest building at present in course of erection, will include two main groups of six and one of four high-speed lifts and seven single lifts in various parts of the building, making a total of 23, installed by the Express Lift Co., Ltd. The building, which is on the site of the ancient Temple of Mithras, will consist of fourteen storeys and will be 170ft high. It will accommodate some 5,000 office workers. The main lifts, with gearless variable voltage drive, will travel at 700ft/min, seven times as fast as an ordinary single-

speed lift. They will each accommodate 15 persons. The single lifts will be of the geared variable voltage and two-speed types.

The lifts in each of the three main groups will be arranged for operation by the passengers themselves and delay at landings will be minimised by automatic closing of the entrances. All passenger movements in and out of the car will intercept an invisible light ray across the entrance to prevent the doors from closing until the entrance is clear. A sensitive edge will be fitted to the car doors causing them to reopen on meeting an obstruction. The light ray equipment supplements this safety device, and is so arranged that should an obstruction, such as a passenger standing in the entrance, remain after a predetermined time, the doors will close at a reduced speed. An automatic supervisory system will be installed whereby the operation of the lifts in each group will be concentrated in the direction of the heavier traffic.

Gauge and Tool Apprentice Training

Early last year the Gauge and Tool Makers' Association issued a booklet entitled "Apprentice Training in the Gauge and Tool Industry." The demand was so heavy that it was quickly out of print. A second edition has now been published which can be obtained from the Association at Standbrook House, 2-5, Old Bond Street, W.1, price 1s (1s 4d post free).

Monsanto Research Laboratories

New research laboratories at the Newport, Mon, factory of Monsanto Chemicals, Ltd., were officially opened on 17th April by Sir Cyril Hinshelwood, President of the Royal Society. They are named the Rideal Laboratories in honour of Professor Sir Eric Rideal, F.R.S., consultant to, and until recently a director of, Monsanto Chemicals, Ltd., who was present at the ceremony.

The laboratories have been designed to augment the already extensive research facilities of the company opened at the Ruabon, Denbighshire, factory in 1949, and the applicational research laboratories at Fulmer Hall, Buckinghamshire, opened in 1951. Their primary function will be to seek means of improving products and manufacturing processes and, by developing new products, to diversify operations.

An outstanding feature is the specially equipped radiation laboratory, housed in a separate building, which represents a major departure from conventional research into a new and highly speculative field of chemistry. It is believed that this is the first industrial radiation laboratory in Great Britain and in it the effects of a variety of chemical processes of nuclear radiation from cobalt 60 will be investigated. Two massive concrete radiation shields have been arranged to permit internal working space sufficient for the setting up of a wide range of chemical equipment. Thus any of the normal laboratory procedures may be conducted under irradiation conditions.

Junior Institution Bursary

The Junior Institution of Engineers invite entries for the annual Durham Bursary competition. Entrants compete by submitting a thesis on some engineering, technical or scientific subject selected by the entrant. Further particulars of the bursary, which is valued at £20, in cash, may be obtained from the Institution at 14, Rochester Row, S.W.1.

Mechanical Handling Exhibition

The fifth Mechanical Handling Exhibition is being held at Earls Court, London, from 9th to 19th May and *Mechanical Handling* (one of the Associated Iliffe group of journals) is covering the exhibition and the concurrent convention in two special numbers—the May Exhibition Preview and the June Exhibition Report, the price being 3s as usual. Copies of these two special issues can be obtained from newsagents, or direct from Dorset House, Stamford Street, London, S.E.1.

Copper Foil

The Royal Mint Refinery of N. M. Rothschild & Sons, 19, Royal Mint Street, London, E.1, is now able to supply copper foil in any quantity likely to be required in this country for some time to come. This is available in continuous length coils in widths of up to 42in and is suitable for bonding with plastic laminates and for etching, in conjunction for instance with printed radio circuits. The copper foil is electro-deposited and has a bright polished surface on one side and a matt surface on the other to ensure a good bond between copper and laminate. The physical properties are in most respects similar to those of hard rolled copper sheet; the purity is a minimum of 99·9 per cent. The thickness available is anything between 0·001in and 0·004in as required, although a thickness of 0·00012in can be provided.

Books for Disposal

We have for disposal the following technical text-books received from one of our readers who suggests that they may be of historical interest:—"The Law Relating to Electric Lighting Traction and Power" (third edition), J. Shires Will, K.C.; "A Treatise on Photometry," A. Palaz, Sc.D.; "Central Electrical Stations," C. H. Wordingham; "Text-Book of Electro-Chemistry," Arrhenius (translated by John McCrae); "Electrical Engineering Testing," G. D. Aspinall Parr; "Faults in Electric Light Mains," Raphael; "The Potentiometer and its Adjuncts," Fisher; "Electric Ions," Leduc; "Central Station Electricity Supply," Gay & Yeaman; "Dynamo Electric Machinery," Sheldon & Mason; "Electrical Engineering," Joyce; "Electrical Traction," Wilson; "Practical Electricity," W. E. Ayrton, F.R.S.; "Electric Traction," Rider; "Electricity and Magnetism," Joubert, Foster and Atkinson; "Absolute Measurements in Electricity and Magnetism," Gray.

Any of these books may be obtained, free of charge, upon application to the Information Dept., *Electrical Review*, Dorset House, Stamford Street, London, S.E.1.

New Jackson Company

Jackson Industries, Ltd., has been formed to manufacture electric cookers, fires and other appliances which will be marketed by the Jackson Electric Stove Co., Ltd. The new company has taken over the Diamond Foundry at Luton which will now be devoted entirely to electrical production.

New Zealand Imports

Imports of electrical machinery and apparatus into New Zealand during the first six months of 1955 were nearly 50 per cent greater in value than in the first half of 1954. The accompanying table gives the values of the chief groups, totalling £7,836,000. Because of changes in classification not all the items are strictly comparable; for example the heading "generators and magnetos" no longer appears and presumably has been incorporated in "other electrical apparatus," which shows a big increase, as also does "cable and wire."

Class of Equipment	Jan.-June, 1955 £ (000)	Inc.or dec. on Jan.-June, 1954 £ (000)
Batteries and cells	26	— 35
Insulating cables and wire	1,610	+ 721
Insulators and parts	32	— 68
Lamp bulbs	112	+ 53
Lamps (not surgical)	311	+ 48
Motors under 1 h.p.	354	+ 103
Motors 1 to 25 h.p. (inclusive)	177	+ 39
Motors exceeding 25 h.p.	97	+ 69
Telegraph and telephone apparatus other than radio	793	+ 28
Transformers and convertors	514	+ 83
Other electrical apparatus	3,234	+ 1,980
Valves for receiving sets and other radio valves	148	+ 69
Other radio apparatus	283	+ 48
Vacuum cleaners and parts	145	— 17

Professional Engineers' Appointments Bureau

The report for 1955 of the Professional Engineers' Appointments Bureau (9, Victoria Street, S.W.1) emphasises the continued shortage of civil, mechanical and electrical engineers. There is no indication that the number of engineers seeking appointments, either at home or overseas, is adequate in any field to fill current vacancies. There are a good many changes by engineers from one appointment to another, either for personal reasons or to gain wider experience, and these changes are of

value to employers generally if the engineers concerned are progressively able to accept greater responsibility, but the difficulty of finding an engineer who is fully experienced in a particular field is not lessened.

In 1955 there was no significant change in the numbers of engineers registering with the Bureau, but the number of vacancies notified increased by 20 per cent. The total placings rose by 15 per cent above the 1954 figure but the more rigid specification of requirements laid down both by those registered and by prospective employers tended to reduce the field of selection. A larger proportion of placings was for senior appointments but with fewer men available for junior posts, the number of placings in the low salary ranges was reduced.

Many more employers and engineers approached the Bureau to discuss their problems, and to review the general employment market. The Registrar is always glad to offer the facilities of the Bureau to any corporate member, graduate or student of the Institutions of Civil, Mechanical and Electrical Engineers who is contemplating a change of post and to any employer who wishes to fill a vacancy.

Diesel Engineers' Luncheon

The Diesel Engineers' and Users' Association held a luncheon on 19th April at the Connaught Rooms, London, the principal guest being Mr. R. C. Bond, chief mechanical engineer of the British Railways Division, British Transport Commission.

Mr. K. H. Tuson, president of the Association, welcomed the guests, and Mr. Bond replied, also proposing the health of the Association. He spoke of the modernisation plans of British Railways, with particular reference to the use of diesel engines. Owing to the high proportion of freight traffic in this country, diesel locomotives would predominate, as distinct from multiple unit stock with individual engines on the coaches. The railways intended to acquire 2,500 main line locomotives, 4,600 multiple unit vehicles, half of them powered, and 1,200 shunting locomotives. Electric traction represented the only way of harnessing nuclear power to the needs of transport but was suitable only for heavily loaded routes; and diesel locomotives gave many advantages in the way of mobility. He stressed that reliability was paramount especially as the higher cost of diesel locomotives compared with steam necessitated their doing more work.

Mr. F. J. Mayor, past-president, replied for the Association.

Works Visit

When she visited the Strowger Works of the Automatic Telephone & Electric Co., Ltd., Liverpool, on 17th April Mrs. Vijaya Lakshmi Pandit, the High Commissioner for the Republic of India, showed particular interest in equipment intended for the Indian market. Sir Thomas Eades (vice-chairman and managing director) and Mr. J. A. Mason (director and manager) accompanied the High Commissioner and her party on a tour of the works.

Sir Thomas Eades, vice-chairman and managing director of the Automatic Telephone and Electric Co., Ltd. (left), Mrs. Pandit, High Commissioner for India, and Mr. J. A. Mason, director and manager, seen at a demonstration private automatic exchange during Mrs. Pandit's visit to the Strowger Works

Women Engineering Workers' Pay

As we have reported the Engineering Employers' Federation have declined to accede to a claim by the engineering trade unions for rates of pay for women workers equal to those of men. On 18th April the Federation recommended federated firms to pay women employees an extra 8s 6d a week as from 5th March. This would raise their basic pay up to £5 13s; the basic rate for unskilled men is £7 2s 4d.

Trade Announcements

The Domestic Appliance and Television Service Department of the **English Electric Co., Ltd.,** in Birmingham, has moved to 175, Tennant Street, Five Ways, Birmingham, 5 (telephone: Midland 2803). The Birmingham Service Department remains in the charge of Mr. D. S. Farmer.

The offices in Port Said of the **Marconi International Marine Communication Co., Ltd.,** are now at C.T.O. Building, app. 3H2, Sharia Sultan Hussein.

The London offices of the **Hotpoint Electric Appliance Co., Ltd.,** the **Coldrator Division** and **Premier Electric Heaters, Ltd.,** have moved to 21, Bruton Street, London, W.1 (telephone: Mayfair 5543). The showrooms remain at Crown House, Aldwych, London, W.C.2.

The Wolverhampton branch of **Permanoid, Ltd.,** is now under the management of Mr. R. G. Beere and the Scottish branch in Glasgow is under the management of Mr. J. Young.

S. H. Simon (Electrical), Ltd., have opened a trade counter at 14, Kingsbury Green Parade, Kingsbury Road, N.W.9 (telephone: Colindale 3117).

Testing Heating Appliances

One of the subjects which were to be considered at yesterday's annual meeting of the Association of Municipal Corporations was a report by the Law Committee suggesting changes in the law to give local authorities power to test heating appliances at the premises of manufacturers and wholesalers. The Committee has suggested to the Home Office that amending legislation should require the name of the manufacturer to appear on each appliance with a stamp indicating that the particular type of appliance has been tested by a local authority. It believes that such amendments to the Heating Appliances (Fireguards) Act of 1952 would avoid the necessity of testing more than one of each type of appliance. The present powers of local authorities to test appliances in retail establishments must be retained because of the sale of foreign and second-hand appliances and as an additional safeguard.

The Committee says that most electric fires of the "bar" type are supplied by manufacturers with a label attached to the bar which carries a guarantee that if the bar is damaged before the label is removed it will be replaced by the manufacturers without cost. Application of the heat test would necessitate either the removal of the label or its consumption by fire and wholesalers and retailers accordingly refuse to remove the label so that the test can be carried out on the ground that if they did so they would lose their indemnity.

TESTING OF MATERIALS

A course on non-destructive testing of materials has been arranged by the British Council, to be held in London from 4th to 17th November. It is intended for industrial technologists and university research workers in science and engineering. Applications should be made to the Director, Courses Department, British Council, 65, Davies Street, London, W.1.

Machinery Trades Convention

Insulating Varnishes and Motor Standardisation

FINE though somewhat chilly weather greeted the delegates to the annual Convention of the Association of Electrical Machinery Trades which was held at the Palace Hotel, Southport, from 14th to 17th April. Delegates with their wives (and in some cases their families) began to arrive on Saturday afternoon and in the evening there was a "get together" and an informal dinner and dance. Sunday was a free day, and a number visited Blackpool while others toured the Lake District.

Insulation Methods

The first business session of the Convention was on Monday morning, and following the Council meeting a discussion was led by Mr. J. Hann, of Griffiths Bros. & Co., London, Ltd., on "Varnishes and Modern Insulation Methods." Mr. F. H. Washington, chairman of the Association, presided.

Mr. Hann commenced by discussing the changes which had taken place during the last few years in the types of electrical varnishes and their relationship to the solid insulating materials now in use. He said that the blacker varnishes were being less used and there was an increase in the more flexible types. In general, greater use was made of oil-modified synthetic resin varnishes. Mr. Hann then referred to the uses of moisture-proof coatings, of the various types of moulding resins and of organic modified silicone materials, which included the polyesters and epoxy resins. He said that modified silicones were a compromise between the true silicones and conventional varnishes. The next point presented for consideration was the methods available for the employment of impregnants and the materials already mentioned. Mr. Hann said that there was less use of vacuum impregnation plant in electrical winding and repair work, but in the radio and electronic branches its use was greater. Government contracts, however, specified vacuum impregnation. Mr. Hann suggested that where gas ovens were used burnt gases, if admitted into the oven, might badly affect varnishes. Infra-red and radiant heating were not satisfactory. Mr. Hann concluded by referring to the future trend of the varnish insulation problems of rotating machines. The various points raised created an interesting discussion, during which reference was made to the good penetration and quick drying properties of modern varnishes. Normal conductivity troubles with water repellents were also mentioned and it was stated that silicones were not impervious to water.

After lunch a coach tour was made to New Brighton, which included a visit to Liverpool Cathedral and the Mersey Tunnel. The dinner and dance in the evening were under the genial chairmanship of Mr. Washington, who was accompanied by Mrs. Washington, and the informality of this function added to the enjoyment of the Convention. Mr. Washington, in a brief speech, welcomed the members and their guests.

Electric Motor Specifications

Tuesday morning was given over to a paper read by Mr. F. T. Bartho, of Crompton Parkinson, Ltd., on "New British Standards and their Effect on our Electric Motor Market."

Mr. Bartho said that in recent years the British Standards Institution had issued two new specifications which had a considerable influence on the electric motor market. The first of these to be issued was B.S. 2083 : 1954, covering the standardisation of fixing dimensions for a limited range of totally enclosed fan-cooled squirrel cage motors, the other, B.S. 2613, was a revision of B.S. 168 : 1936, dealing with the rating of motors.

Progress in the development of standardisation of fixing dimensions for motors had been slow, but the principle was now established. The dimensions adopted were the result of the report of the Lemon Committee set up by the Government to investigate, in consultation with the B.S.I. and appropriate organisations, the problem of simplification and standardisation within the engineering industry. They were based on N.E.M.A. specifications which had since been changed, but the principle was established. Standardisation of fixing dimensions created competition between manufacturers in the service offered to customers, and the section of the industry covered by the A.E.M.T. provided a local repair service in which he believed the majority of manufacturers did not wish to compete. In the days of d.c. and frequency change-overs it was a common opinion that this section of the industry would be severely reduced, but as the number of standard motors in use increased so would the off-the-shelf service which it rendered to industry increase. Many designers and manufacturers did not appreciate the scope of the activities of the Association's members and Mr. Bartho asked for closer co-operation between the two parties. As ratings were increased and production costs reduced it became increasingly difficult to carry out a complete re-wind of a small motor at a price competitive with that of a new motor. This applied particularly to fractional h.p. motors.

Thermal Rating

The thermal rating of motors had for many years been based on internationally agreed maximum temperatures, namely, 105 deg C for Class A and 130 deg C for Class B insulation. There were, however, available new synthetic enamel wires which were satisfactory up to 120 deg C and the silicones up to 180 deg C. Although the thermal rating of motors was based on a maximum safe temperature of 105 deg C for Class A insulation this was not stated in B.S. 168, and had caused difficulty in recent times, as after the application of sustained overload for a period the cooling time was not specified before the overload could be repeated, nor was the temperature rise due to overload. Two ratings were established, a continuous nameplate rating with a temperature rise of 40 deg C and an overload rating corresponding to 55 deg C, the overload comprising a number of applications of 25 per cent sustained overload or 50 per cent overload for one minute. These ratings had become established as continuous rating permitting overloads and continuous maximum rating. Both were recognised for large machines in 1925 by B.S. 169 and 226 respectively.

It had been suggested that the introduction of B.S. 2613 would reduce prices, and it had in large sizes. But the largest demand was for motors of about 7½ h.p. and in this range the standard horsepower steps were much coarser preventing the next smaller frame being used.

The new rating specification B.S. 2613 had not changed a well-established principle, but combined four specifications, namely, B.S. 168, 169, 225 and 226 in one specification. There had been relatively no increase in the rating of active material but merely a change in arriving at the nameplate rating. Providing this fact was appreciated and the horsepower rating of the motor to r.m.s. duty cycle of the application was matched, the revision should improve efficiency and reduce the capital expenditure on electrical equipment.

A general discussion on the points raised in Mr. Bartho's paper followed, in the course of which it was suggested that in regard to closer co-operation between the manufacturers and the members of the A.E.M.T., the approach should be made by the manufacturers, who, it was stated, were reluctant to impart information.

GENERATION AND DEVELOPMENT

Output at Lower Level in March

Last month the normal seasonal decline in electricity output was accentuated by three factors. In February the exceptionally cold weather and the extra day in that month owing to Leap Year resulted in a rise of 20·7 per cent in output compared with a year ago, and the March figure was affected by the commencement of the Easter holiday, which fell early this year. Last month's output was in fact only 0·1 per cent higher than in March, 1955 (see Table 1).

A point of interest, as indicating the rise in average plant efficiency, is the fact that fuel consumption was less than a year ago although the 7,659 million kWh generated at steam stations was slightly more.

New plant commissioned by the C.E.A. last month included a 60 MW English Electric set and a 550,000 lb/hr John Thompson boiler at Marchwood; a 360,000 lb/hr John Brown boiler at Carrington; a 180,000 lb/hr John Thompson boiler at Woolwich; and a 60 MW Parsons set and 500,000 lb/hr Clarke Chapman boiler at Stella North.

Table 2 analyses the sales of the twelve Electricity Boards in England and Wales. The national figures show a decrease over March, 1955, of 0·4 per cent, but when corrected for weather conditions and working days, there was an increase of 8·8 per cent. The total number of effective working days last month was 28·86 against 28·21 in March, 1955.

Part of the new Staines electricity service centre

TABLE 1.—ELECTRICITY GENERATED AND PLANT INSTALLED

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total		
Central Electricity Authority ...	3,696	85	31·1	7,148	7	7,164	6,725	20,640
North of Scotland H.E.B. ...	25	—	1·3	40	107	152	150	724
South of Scotland E.B.	257	6	—	471	19	490	464	1,251
Total for March, 1956	3,978	91	32·4	7,659	133	*7,806	7,339	22,615
Corres. total for March, 1955 ...	4,051	125	24·2	7,654	124	7,795	7,342	20,819
Inc. or dec., per cent	−1·8	−27·2	+34·0	+0·1	+7·1	+0·1	—	+8·6
Total to date (3 months) 1956 ...	13,051	272	104·9	24,686	461	25,204	23,728	
Total for corres. 3 months of 1955	12,160	347	74·4	22,599	434	23,082	21,752	
Inc. or dec., per cent	+7·3	−21·7	+40·9	+9·2	+6·2	+9·2	+9·1	

* The total figure includes generation by other methods amounting to 14 million kWh.

TABLE 2.—ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for March (million kWh)			Twelve Months Totals Ended 31st March (million kWh)		
	1955	1956	Inc. or Dec. %	1955	1956	Inc. or Dec. %
London	690·3	653·7	− 5·3	6,283·7	6,738·2	+ 7·2
South Eastern	403·4	401·5	− 0·5	3,772·0	4,175·0	+10·7
Southern	480·8	484·9	+ 0·9	4,523·7	5,012·8	+10·8
South Western	243·0	247·3	+ 1·8	2,335·7	2,565·6	+ 9·8
Eastern	652·1	646·2	− 0·9	6,167·1	6,739·1	+ 9·3
East Midlands*	546·9	538·3	− 1·6	5,282·8	5,733·7	+ 8·5
Midlands*	740·4	719·5	− 2·8	7,067·2	7,532·8	+ 6·6
South Wales*	398·9	404·3	+ 1·4	4,062·9	4,394·3	+ 8·2
Merseyside and N. Wales* ...	417·8	418·9	+ 0·3	4,088·4	4,511·1	+10·3
Yorkshire*	693·4	710·7	+ 2·5	6,850·3	7,471·9	+ 9·1
North Eastern*	398·7	397·6	− 0·3	4,034·8	4,307·4	+ 6·8
North Western*	748·7	738·4	− 1·4	7,567·4	7,964·4	+ 5·2
Total all Area Boards	6,414·4	6,361·3	− 0·8	62,036·0	67,146·3	+ 8·2
Direct Supplies by Central Authority	144·5	173·7	+20·2	1,430·6	1,815·6	+26·9
Grand Total	6,558·9	6,535·0	− 0·4	63,466·6	68,961·9	+ 8·7
Mainly Industrial Areas*	3,944·8	3,927·7	− 0·4	38,953·8	41,915·6	+ 7·6
Mainly Non-Industrial Areas ...	2,469·6	2,433·6	− 1·5	23,082·2	25,230·7	+ 9·3

* Those in which industrial consumers took over 50% of the total sales in the preceding financial year.

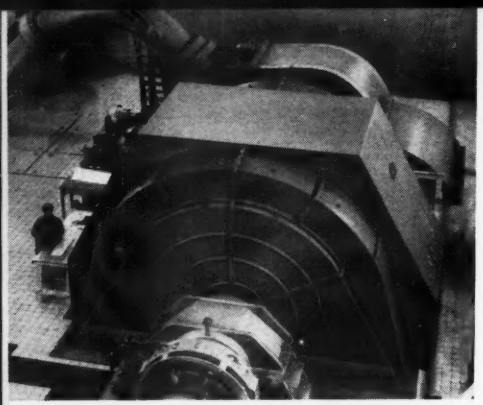
Staines Electricity Showrooms

Last week a new service centre and showrooms were opened by the Southern Electricity Board at Clarence Street, Staines. The existing premises in The Causeway date back to 1911 when the Egham & Staines Electricity Co. was formed. At that time there were under 200 consumers within the district; since then the area has grown to 133 square miles and the number of consumers has increased to over 68,000, yet it continued to be served by The Causeway premises, to which only small modifications had been made. The site for the new showrooms was purchased by the former "Metesco" company in 1945, but owing to post-war difficulties the project was not proceeded with. Now, more than ten years later, the new showrooms are completed and consumers are provided with more convenient premises with facilities for cookery demonstrations, the displaying of a comprehensive range of electrical appliances, and for dealing with inquiries, estimates and general service problems.

The total showroom floor area is some 2,200 sq ft and the carpeted floors provide a friendly atmosphere. Ekco triple fluorescent lighting fittings are installed and for the two large window displays pleasing lighting effects are obtained by the use of a fluorescent colour change system and four tungsten spotlights. Heating is by a system of thermal storage heaters which, apart from its practical use, serves as a working demonstration which should be of interest to local commercial and industrial consumers.

Exeter Service Centre

On 17th April Alderman A. E. Brock, who was chairman of the Exeter Corporation Electricity Committee from 1923 until vesting day in



G.E.C. turbo-alternator set in the Aura power station

1948, officially opened the South Western Electricity Board's new showroom and service centre in the city.

The new premises, which replace temporary ones acquired after the destruction by bombing of the original showrooms, are spaciously laid out with all the usual items of electrical equipment, with an example from an actual local housing estate of a good all-electric kitchen, and with a fine lecture and demonstration room. Heating in the main showrooms is by "Panelec" embedded under-floor heating, with a section of floor cut away and covered in glass to demonstrate what is involved for the benefit of customers. In the demonstration room heating is by night storage type electric heaters.

Electrically, Exeter claims pride of place in Devon, having been the first place in that county to have a public electricity supply, in 1889.

Alderman Brock was introduced by Mr. A. L. Keet, the district manager, and thanked by Mr. A. N. Irens, the Board's chairman, who said that this summer they would be connecting up their 200,000th consumer since nationalisation.

New E.M.E.B. Stamford Headquarters

The headquarters of the Stamford District of the East Midlands Electricity Board are now at 14, Barn Hill, Stamford, Lincs (telephone: Stamford 2453).

Cookers—Electric or Solid Fuel ?

After considering the provision of cooking facilities in Council houses, Stanley (Co. Durham) U.D.C. has instructed its surveyor to submit comparative costs for both electric and solid fuel cooking arrangements in future housing programmes.

Change-over in Worthing District

There are at present about 50,000 consumers in the South Eastern Electricity Board's Worthing District, of whom approximately 3,700 are supplied with d.c. According to a report by the Mid-Sussex Sub-Area manager to the Consultative Council, at to-day's prices the cost of changing these consumers over to a.c. would be in the vicinity of £130,000. The Board has already approved a proposal for changing over some 500 consumers at a cost of £16,000 and before the present financial restrictions came into force a further proposal was in preparation for changing over another 300 consumers at a cost of £9,000. Because of the restrictions, however, it has been possible to allocate only £16,000 for change-over work in the Worthing area during 1956-57.

Aura Power Station, Norway

The 62·5 MVA alternator for the Norwegian Aura power station was supplied by the General Electric Co., Ltd. This station was built for a new aluminium plant at Sunndalsora and like many others in the country is constructed inside the mountains. Power is transmitted from the generating station through twelve parallel three-phase cables and overhead lines to the busbars in the aluminium works.

The turbine is an Escher Wyss Pelton wheel running at 428·6 r.p.m. The alternator generates at 12·3 kV, ·85/·95 power factor. The combination is one of the largest horizontal shaft hydro sets in service on the Continent. The alternator, which has a total weight of 310 tons, is cooled by a closed-air circuit in which cool air is drawn from the alternator pit by two fabricated centrifugal fans, one at each end of the rotor.

Contractors Criticised

Electrical contractors who had persuaded householders at Gateshead to have their houses wired for electricity in the belief that supply cables were about to be laid by the North Eastern Electricity Board were criticised at a meeting of the Electricity Consultative Council.

Mrs. Pearson, a Gateshead representative, said that some houses in Gateshead had been wired for electricity although there was no prospect of a supply being available until 1958. She alleged that one contractor had been obtaining orders for wiring work and had been telling householders that an electricity supply would be available soon. This contractor was being followed by another who promised a supply at an earlier date if he was given the wiring contract.

Ald. Bloom said no contractor was given preferential treatment over another, and those who promised a quick supply were deluding the public.

The Consultative Council agreed to issue a public announcement that contractors had no authority to promise an early supply of electricity for the purpose of securing wiring contracts.

Precarious Power Position in Ulster

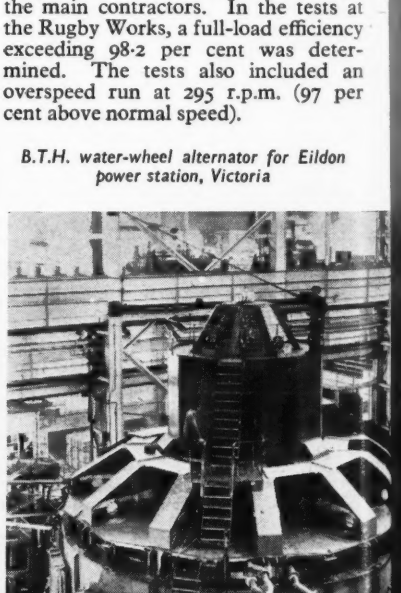
Lord Glentoran, Minister of Commerce, gave a warning last week that even a minor breakdown at a generating station would mean power cuts in Ulster next winter. A White Paper would be published on future plans for electricity. When presenting the Ministry's estimates he said, "If we have fair weather, and no mechanical troubles, we should get through without power cuts. On the other hand, a very little misfortune, or a very little carelessness, would precipitate one." The demand had shown a steady increase of about 8 per cent each year and the provision of sufficient plant and an efficient transmission system was becoming more urgent every year.

Owing to the delay in installing additional plant in Belfast Power Station West, a generator which should have been in operation this autumn would not be ready to operate before the autumn of 1957. During the coming winter, when the demand for power was at its peak, it was expected that all the generating plant available, including some that was very old and almost obsolete, would be working to full capacity. Lord Glentoran said that the work now in progress at Belfast Station West should ensure adequate supplies, even in the peak periods, in the winter of 1957-58.

Large Water-wheel Alternators for Australia

The water-wheel alternator shown in the accompanying photograph in the Rugby Works of the British Thomson-Houston Co., Ltd., is one of two 66,670 kVA, 150 r.p.m. machines being supplied to the State Electricity Commission of Victoria, Australia, for its Eildon power station. The alternators will be driven by Francis turbines supplied by Boving & Co., who are the main contractors. In the tests at the Rugby Works, a full-load efficiency exceeding 98·2 per cent was determined. The tests also included an overspeed run at 295 r.p.m. (97 per cent above normal speed).

B.T.H. water-wheel alternator for Eildon power station, Victoria



The 'Empress of Britain'

ELECTRICAL INSTALLATION IN THE C.P.R.'s LATEST PASSENGER SHIP

LAST week saw the maiden voyage of the s.s. *Empress of Britain*, the first post-war passenger liner to be built by the Canadian Pacific Railway Co. The order for this ship was placed in November, 1952, with the Fairfield Shipbuilding & Engineering Co., Ltd., Govan, Glasgow, and she was launched in June, 1955, by the Queen. The gross tonnage is 26,000 and the vessel has an overall length of 640ft, a breadth of 85ft and a draught of 29ft. Propulsion is by two sets of Fairfield/Pametrada double reduction geared turbines designed for a combined output of 27,000 s.h.p. in service and 30,000 s.h.p. maximum. The turbines operate at 600 lb/sq in and 850 deg F with reheating to 850 deg F between the h.p. and i.p. cylinders. The average speed is planned to be 20 knots and the ship can take a total of 1,050 passengers and requires a crew of 464.

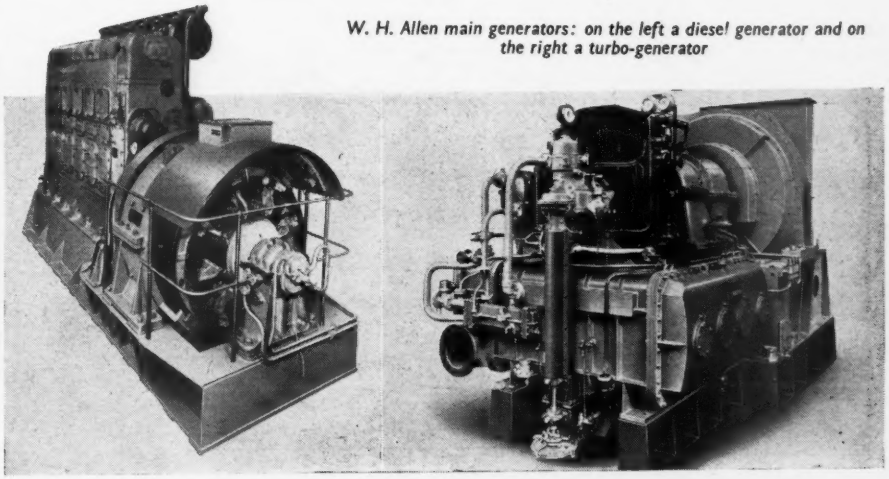
The main electrical generating plant consists of two 1,200 kW 225 V turbine driven generators and three 500 kW diesel driven sets all supplied by W. H. Allen, Sons & Co. Two 100 kW diesel generators are available for emergency use. The estimated sea load can be met with one turbine and two diesel generators. Three 120 kVA 230 V Mawdsley alternators are installed for the supply of cold cathode lighting, shaver and blanket sockets, etc.

Main distribution is on the ring main system with the port and starboard runs arranged on different decks to give vertical and horizontal separation. Altogether, five separate rings are provided covering forward accommodation, aft accommodation, galley, machinery spaces and air-conditioning machinery. The distribution is arranged to suit the sub-division of the vessel into fireproof zones, there being five of these each with its own auxiliary switchboard serving power, lighting and ventilation in that zone. Ventilation circuits are so arranged that all ventilation in accommodation can be switched off from the wheelhouse or emergency generator room, ventilation in machinery spaces being similarly controlled from the engineer's accommodation and the main switchboard room.

The main and auxiliary d.c. 220 V switchboards and the 230 V a.c. board were supplied by Whipp & Bourne, Ltd., connection to the generators from the main d.c. board being by solid copper busbars. The main switchboard is flanked on either side by contactor starter panels, supplied by Brookhirst, for heavy engine room and boiler room auxiliaries and for the motor alternators, each of these auxiliaries being controlled from its respective control position. Preference tripping is provided to ensure that in the event of a failure of the turbo-generator the load will be reduced in 3-5 second stages to within the capacity of two diesel generators. A total of 340 motors aggregating 5,500 h.p. are installed for driving auxiliaries, etc., more than 1,000 h.p. being absorbed in air-conditioning machinery which includes four 210 h.p. compressors.

Cold cathode lighting is used for the illumination of all public rooms, twin tube runs of gold and ivory being used and the circuits arranged to give separate switching for both colours in individual panels and features. The bulk of this lighting is of the concealed cornice type. Altogether, 9,500ft of cold cathode tube, 4,600 2ft fluorescent tubes and 4,500 tungsten lamps are installed. D.c. fluorescent lighting is used exclusively for general lighting in passenger and crew cabins, alleyways, hospital and galleys, the Philips T.L.R. 20 instant starting system being used. All lighting equipment in the public rooms was supplied by the General Electric Co., Ltd., in conjunction with Claude General Neon Lights, Ltd.

Ten lifts, a cinema, a clock system and an extensive fire protection and alarm system are provided and a complete public address system comprising 127 loudspeakers. A 75-line automatic telephone exchange is also installed with three lines for ship-to-shore communications. Navigational aids provided include marine logs and echo sounding equipment by Kelvin Hughes, radar and Decca navigator by Decca and a gyro compass with six repeater stations by S. G. Brown. Excellent communication facilities are provided by Marconi radio equipment.



W. H. Allen main generators: on the left a diesel generator and on the right a turbo-generator

Science and Technology in Industry

IN an address to the South Wales Branch of the Institute of Physics on "Science and Technology in Industry," Sir John Cockcroft, the Institute's president, stressed how fundamental physical research had revealed whole new technologies to the world. He instanced radar, computers, transistors and nuclear power. High intensity short wave radiation of materials was now being investigated and would result in considerable future development—in the U.S.A. six hundred research staff would soon be employed on the problem of preserving food by radiation.

He dealt particularly with the proportionate research staffs and expenditures in various aspects of the country's activities. Annual expenditure on research and development on railways, shipbuilding and automobiles was £350,000, £200,000 and £3 million, respectively. This contrasted with about £100 million on the aircraft industry and a total of civil applied research of over £60 million. Expenditure on fundamental research in this country was 5 per cent of the total and the numbers engaged in it were about 10 per cent of the total graduates on research. The corresponding American proportion of expenditure was 7 per cent.

NEW ELECTRICAL EQUIPMENT

Domestic Fan

A small size domestic or office desk fan, giving an air displacement of approximately 560 cu ft/min, is available from AUSTIN CLARKE (LONDON), LTD., Champion Works, Newhaven, Sussex. It is an 8in diameter three-bladed fan, the blades being manufactured from a polythene moulding as a precaution against accidents.

The motor, which is suitable for 100/125 or 200/250 V a.c., is housed in a two-piece plastic moulding available in various colours. The stand is in similar material, and weighted. It

Austin Clarke (London) "Cygnet" fan

can be used in the standing position or as a wall fixing, in four alternative positions.

The new fan—the "Cygnet"—stands 10¾in high and total weight is 3½ lb. An on-off push-button switch is provided together with 2 yd of 3-core p.v.c. covered flex. The price is £3 1s 8d plus 13s 4d purchase tax in the United Kingdom.

Switched Socket-Outlets

The latest range of 3-pin (round-pin) switched socket-outlets produced by J. A. CRABTREE & CO., LTD., Lincoln Works, Walsall, Staffs, have a matched appearance with a.c. flush switches and 13 A accessories. The new switched socket-outlets comply with B.S. 546 and B.S. 1299 so far as these standards are applicable and the range comprises shockproof and metalclad flush and surface units in 5 and 15 A a.c. patterns, the surface shockproof patterns having recessed "Jacelite" bases with cable entries at the bottom and both sides. These latter patterns may be installed without a mounting block and are specially suitable for concealed and surface wiring.

The switch component in these new units is fitted with a moulded nylon dolly, silver-inlaid contacts, indirect friction-free roller drive; and shrouded mechanism. The socket-outlet is fitted with a flat fibre shield operated through a cam by the earth pin of the plug.

Positional Welding Electrode

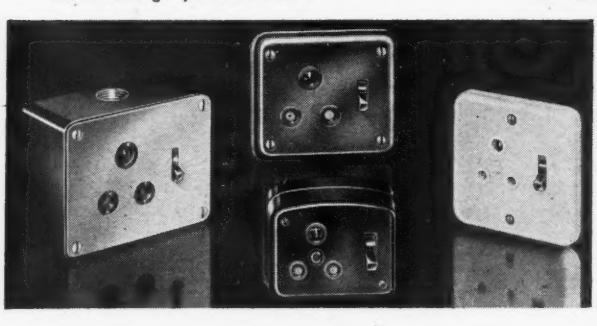
A new electrode has been produced by QUASI-ARC., LTD., of Bilston, Staffordshire, of particular interest to fabricators of oil storage tanks, gas holders and other site-erected structures. Known as the "Vertispeed," it is a general purpose electrode for welding mild steel in all positions and gives welds of high radiographic standard. It is particularly recommended for producing horizontal-vertical and vertical butt welds. A special feature is the ease of welding possible in all positions which, combined with the excellent slag detachability and high deposition speed, makes it particularly attractive to the operator. The electrode is supplied in sizes from 12 to 6 s.w.g., in 15in lengths so that full advantage can be taken of the maximum welding currents to give fast economical welding. The electrode is approved by the Ministry of Transport and Civil Aviation and by Lloyd's Register of Shipping for the welding of mild steel in all positions.

Plug-in Photocells

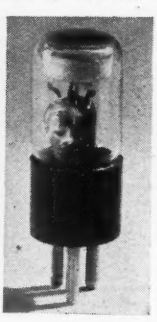
In some applications the use of end-viewing photocells with wire-in connections is inconvenient or undesirable. MULLARD, LTD., Century House, Shaftesbury Avenue, London, W.C.2, have therefore introduced plug-in versions of two of their wire-in photocells.

Both of these have B3A ("pee-wee") bases. The 53CG is a gas-filled photocell equivalent to wire-in type 58CG, and the 53CV is a vacuum type equivalent to wire-in type 58CV. Both are sensitive to incandescent and near infra-red light.

Matched range of socket-outlets



End-viewing plug-in photocell



Flameproof Annunciator

A flameproof annunciator has been introduced by SIEMENS-SCHUCKERT (GREAT BRITAIN), LTD., Faraday Works, Great West Road, Brentford, Middlesex. It is intended to give a double warning in hazardous atmospheres by means of a light and a horn, before the occurrence of a failure. The annunciator is initiated by a remote relay and is suitable for wall or switchboard mounting with provision if required for access from the rear as well as the front. On operating two lights come on and the horn sounds. Manual cancellation of one of the lights and the horn is then possible, the other light remaining until the fault condition has been attended

Siemens-Schuckert annunciator

to. The enclosure is of cast aluminium with overall dimensions of approximately 12in by 6in by 6in. It is certified flameproof for groups I, II and III.

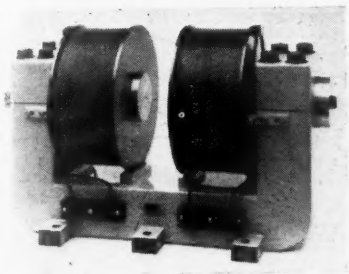
L.V. Lighting Transformers

A range of low voltage lighting transformers is being marketed by G. H. LUCAS & CO., 3, Marlborough Road, Altrincham, Ches. These are manufactured by Dynamo & Electrical Services, Ltd., and are intended for machine tools or bench use. Transformers are available with a twin tapped output or with a single output, the input voltages covered being 230 and 440, the output voltages 12, 25 and 50 V and the loading 60 or 120 VA. Plug and socket outputs can be fitted to the transformers if required.

High Performance Electromagnet

NEWPORT INSTRUMENTS (SCIENTIFIC & MOBILE), LTD., of Newport Pagnell, Bucks, have produced a new high performance electromagnet manufac-

tured to Clarendon Laboratory design and intended for application in basic research and in the television, radio and electronics industries. It is



Newport Instruments electromagnet

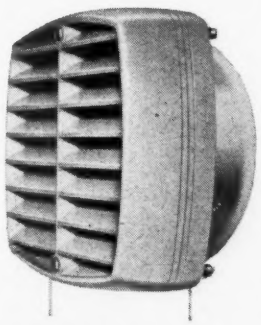
robust, low in cost and light in weight. Magnetic field strengths up to 10 K oersted are possible at 2 cm separation of the pole pieces, with a current as low as 10 A.

The magnet can be supplied with fixed or adjustable pole pieces, the standard ones being machined from mild steel, but if required they can be made from nickel iron or other special materials. The standard magnet supplied is with plain tips of 100 mm diameter, the pole piece tips are interchangeable, and angle or conical tips are available. The maximum continuous current of the coils in parallel is 8 A with a loading of 600 W. Cooling is by natural convection.

Window Fans

The traditional outlet baffle has been replaced by a pleasingly styled moulded external grille in new models of the "Xpelair" window fan recently announced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.

Square with curved sides, the new grille is neater, much more compact and less conspicuous than the conventional circular baffle and it is



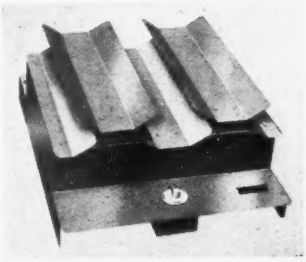
G.E.C. "Xpelair" window fan

claimed to be weatherproof. The new models are supplied with an integral iris shutter, preventing back draught when the fan is not running. Operation of the shutter by two nylon cords trips a built-in fan switch—a pull on one cord starts the fan and opens the shutter—a pull on the other switches it off and seals the aperture.

A new size with a 6in diameter fan, extracting 7,500 cu ft/hr, has been introduced. Finish is in ivory plastic and it is suitable for the average small kitchen. The price is £8 without shutter, or £11 3s with shutter. The two larger models, with 7½ and 9½in fans, extract 15,000 and 30,000 cu ft/hr respectively. These are now produced in black plastic. For all three sizes a new type of wall plate is offered, which facilitates fixing the unit into brick walls.

Drying Cabinet Heater

A new drying cabinet heater (type TD25) is the latest addition to the "Thermovent" range of heating equipment produced by E. K. COLE, LTD., Ekco Works, Southend-on-Sea. It is intended for installation near the bottom of suitably ventilated drying cupboards or portable cabinets and is



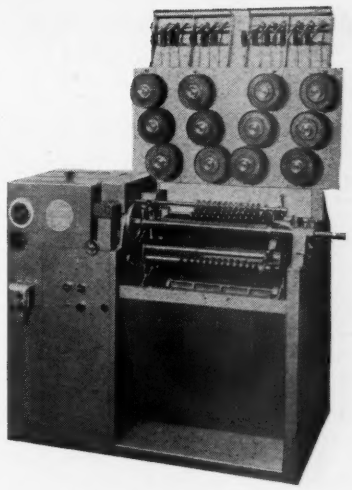
"Thermovent" drying cabinet heater (E. K. Cole, Ltd.)

so designed that the incoming air must pass over the heating elements and be directed out through the top louvres in a continuous flow to the articles to be dried.

A three-heat switch gives a choice of loadings of 625, 1,250 or 2,500 W and the elements and all electrical connections are enclosed to provide maximum safety. The frame of the heater is constructed of stout gauge sheet steel, heavily cadmium-plated and treated to avoid corrosion, and it measures 10in high by 17½in wide by 23in deep. Voltage ranges are 200/220 and 230/250 a.c.

Coil Winder

The principal feature of a new multi-coil winder by WESTOOL, LTD., St. Helen's Auckland, Co. Durham, is its ability to accommodate 12 reels each of 6in diameter with a winding range of from 20 to 46 s.w.g. The machine has a traverse from $\frac{1}{16}$in to 6in with a maximum effective winding length of 18½in and an automatic cut-out operates in the event of wire breakages. The maximum coil diameter is 4¾in and the minimum ⅝in. When changing from one gauge wire to another, the operator or setter can see the required setting on a small dial. The coil winder is driven by a 1·25 h.p. motor with electric



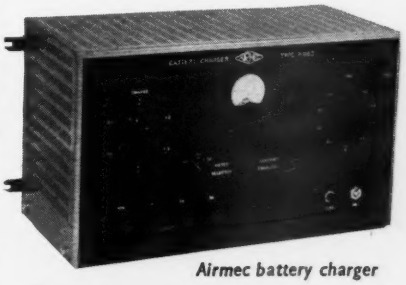
Westool twelve coil winder

clutch control ensuring smooth acceleration from 0-2,500 r.p.m.

The winder has a predetermined electric revolution counter with a Warner electric brake on a mandrel headstock to ensure accurate control and prevent over-running. Starting is by means of an "inching" pedal after which push-button control becomes effective and the machine runs automatically.

Battery Charger

AIRMEC, LTD., High Wycombe, Bucks, have produced a new battery charger, type P.863. This unit is essentially a small one, intended primarily for charging car batteries in series, the number of batteries on charge being such that the total voltage is between 6 and 24 V. The unit consists of a transformer, a full-wave metal rectifier, fine and coarse adjustment tapping switches, a current



Airmec battery charger

equalising potentiometer, an indicating meter and a meter selector switch. The supply is unsmoothed and is capable of providing charging rates of up to 10 A for a single bank of batteries or up to 3 A for three separate banks of batteries, two banks of which may be maintained at equal currents by means of a potentiometer. It is suitable for either 100-130 or 200-260 V a.c. input and is finished in black stove enamel with a perforated metal cover finished grey.

Financial Section

STOCKS and SHARES

STOCK EXCHANGE markets assumed for some days a decidedly cheerful appearance in dealing with the large accumulation of investment orders pent up earlier by Budget uncertainties, and subsequently released by the absence of any serious deterrents in the Chancellor's proposals. After the first flush of business, the industrial market had begun to show signs of returning sobriety by the beginning of this week, but many share prices were left with sizeable improvements. Gilt-edged stocks followed the rise more sedately, but were pulled up by the unexpected announcement of a new £250 million Government loan. In the electrical equipment market, the main event was the appearance of excellent figures from British Insulated Callender's Cables, which carried on the tale already told by other companies of greatly improved business last year in the cable manufacturing industry.

B.I.C.C. Results

The final dividend of 8½ per cent now declared by B.I. Callender's had already been indicated at the time of last October's big issue of ordinary shares. Although it was also stated then that profits were showing a substantial improvement on the previous figures, the extent of the increase now reported for the full year 1955 surpassed market expectations and was responsible for an initial rise in the price of the £1 shares from 50s 6d to 54s 3d. With the interim dividend of 4 per cent paid before the capital issue, the total distribution is brought up to 12½ per cent, which compares with last year's 10 per cent dividend plus a special 2½ per cent tax-free payment. Despite much larger tax and other provisions, the net profit of £5·1 million is 60 per cent larger than before, and provides fourfold cover for the new rate of dividend.

Electrical Equipment Shares

On the strength of the B.I.C.C. results, the shares of other cable manufacturing companies took a prominent part in the all-round advance of industrial share prices. Johnson & Phillips were particularly well supported, rising 4s 6d to 44s 6d. Henley's, Hackbridge and Aberdares added well to previous improvements. A.E.I. continued to advance strongly to 70s, with the new shares at a premium of 12s. Parsons and Reyrolle were again active and higher, while Plesseys put on 5s. The radio group joined the upward movement. Ever Ready were especially good in advance of the final dividend declaration, rising 3s 6d, and there were useful gains in Pye, Ekco, Thorn and Cossor. Among motor accessory shares, Lucas and S. Smith were both 1s 6d better, and among many other good features mention may be made of Clarke Chapman, Westinghouse, Murex and Tube Investments.

Elliott Brothers

Investment interest in the future of electronic computers and kindred

Price Changes in

Company or Board	Nom. Value	Middle price 23rd Apr.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	77½	+1	3	3	3 17 6	94¾	76½
Brit. Elec. 1974/77	100	76½	+2	3	3	3 18 6	93½	75½
Brit. Elec. 1976/79	100	80½	+1	3½	3½	4 7 0	98¾	80½
Brit. Elec. 1974/79	100	91½	+2	4¼	4¼	4 13 0	109	90½
Overseas Electric Supply								
Calcutta Elec.	£1	20/-		6†	6†	6 0 0†	22/6	20/9
East African Power	£1	20/9		7	7	6 15 0	24/6	19/9
Nigerian Elec.	£1	20/9		10	10	9 12 9	27/-	21/-
Palestine Elec. "A"	£1	21/-		Nil	Nil	Nil	22/9	21/-
Perak Hydro-Elec.	£1	16/-		10	10	—	22/3	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	13/6	+6d	17½	17½	6 9 9	14/6	11/-
Aeralite	1/-	5/6	+3d	88½	45*	8 3 6	6/9	5/3
Allen, W. H.	£1	70/-		20	20	5 14 3	83/9	74/6
Aron Elec. Ord.	£1	55/9	+1/6	15	15	5 7 6	63/9	55/6
Assd. Automation	10/-	27/-		10	10	3 14 0	32/-	11/-
Assoc. Elec. Ord.	£1	70/-	+2/6	14	15	4 5 9	96/-	62/6
Automatic Tel. & El.	£1	67/6	+5/-	15	15*	4 9 0	79/6	60/-
Babcock & Wilcox	£1	82/6	+3/9	12*	15	3 12 9	98/-	68/6
Baldwin, H.	2/-	4/3		20	20	9 8 6	5/6	4/4
Bakelite	10/-	27/-	+6d	16	16	5 18 6	34/6	27/-
Berry's Electric	5/-	6/-		—	10‡	8 6 8	—	—
British Aluminium	£1	53/-	+6d	12	12	4 10 6	58/-	35/3
B.I. Callender's	£1	54/3	+3/9	10	12½	4 12 3	55/3	44/9
B.I. Callender's 6% Pref. ...	£1	22/-		6	6	5 9 0	26/6	21/9
British Thermostat	5/-	28/9	+2/6	27½	27½	4 15 0	35/-	22/6
British Vac. Cleaner	5/-	7/3	+3d	30	15*	10 7 0	10/-	6/6
Brook Motors	10/-	40/-	+6d	20	25	6 5 0	47/-	39/9
Brush Ord.	5/-	7/-x.d.	+3d	10	10	7 2 9	9/6	7/6
Bulgin, A. F.	1/-	7/3x.d.	+3d	45	50	6 18 0	8/-	4/-
Burco Dean	5/-	9/6	+9d	—	22½	11 16 9	17/3	12/-
Chloride El. Storage "A" ...	£1	67/-	+9d	17½	17½	5 4 6	77/6	58/6
Clarke Chapman	£1	102/6	+5/6	20	22½	4 7 9	102/6	68/9
Cole, E. K....	5/-	18/3	+1/6	27½	17½*	4 16 0	25/6	18/3
Cossor, A. C.	5/-	8/6	+9d	10	15	8 16 6	14/-	8/9
Crabtree	10/-	28/6		20	20	7 0 3	34/6	27/6
Crompton Parkinson Ord. ...	5/-	14/9		20	16*	5 8 6	19/9	15/-
De La Rue	5/-	19/9	+1/-	20	30	7 12 0	26/-	17/-
Decca	4/-	30/9	+1/3	56¼	43¾*	5 13 9	48/9	31/-
Desoutter	5/-	26/6		25	30	5 13 3	35/-	25/6
Dewhurst	2/-	12/-	+6d	24	30	5 0 0	11/3	7/3
Dictograph Tel.	2/-	6/3		20	20	6 8 0	9/3	9/6
Dubilier Condenser	1/-	4/3		25	25*	5 17 9	5/7	3/1
E.M.I.	10/-	30/6	+1/9	10	15	4 18 3	37/-	25/3
Electrical Components	5/-	13/9		20	25	9 1 9	21/3	13/9
Elec. Construction	£1	27/6	+3d	15	8½	6 3 9	41/3	28/9
Enfield Cable Ord.	£1	18/-	+1/-	Nil	Nil	Nil	25/3	18/6
English Electric	£1	57/6		12½	12½	4 7 0	86/9	54/3
English Electric 3½% Pref. ...	£1	13/3		3½	3½	5 13 3	16/9	14/-
Ericsson Tel.	5/-	40/-	+2/-	25†	25*†	3 2 6†	46/6	29/-
Ever Ready	5/-	32/6	+3/6	40	35*	5 7 9	38/-	2/3
Falk Stadelman	£1	38/9	+1/3	15	17½	9 0 9	52/6	42/-
G.E.C. Ord.	£1	57/6		12½	14	4 17 3	80/3	51/3
G.E.C. 6½% Pref.	£1	22/9		6½	6½	5 14 3	28/4	23/6
General Cables	5/-	12/9	−9d	30	30	11 15 3	17/-	15/-
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	57/6	45/-
Hackbridge Cable...	5/-	24/3	+6d	20	25	5 3 0	23/9	14/-
Hackbridge & Hewittic	5/-	17/9		25	30	—	24/9	17/-
Heatrae	2/-	4/9		12½	15	6 6 3	5/9	4/3
Henley's	10/-	18/3	+1/6	10½	10½	5 15 0	21/3	15/6
Holophane...	5/-	17/6		25	30	8 11 6	19/9	16/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend forecast.

apparatus has helped to bring the 5s ordinary shares of Elliott Brothers (London) well to the fore during the last year or two. In the course of this month they were run up from 27s to 34s in anticipation of the annual results, which have now been published, and subsequently lost part of the rise in reverting to 32s. The final payment of 12½ per cent makes, with the interim, 17½ per cent for the year on the increased ordinary capital of £540,000. Earnings of the business are shown in the preliminary statement to have continued on their upward course in rising by one-third to £146,000 (after tax). A yield of 2¾ per cent on the shares gives the measure of the scope considered to exist in the company's fields of enterprise.

Electrical Investments

Company or Board	Nom. Value	Middle price 23rd Apr.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	28/-	+6d	70	50	8 18 6	52/6	35/6
I.C.I.	£1	49/3	+3/6	15	10*	4 1 3	61/9	38/3
Intl. Combustion	5/-	20/6	+1/-	25	20*	4 17 6	24/6	16/-
Johnson & Phillips	£1	44/6	+4/6	15	15	6 14 9	52/6	39/6
Lancashire Dynamo	£1	45/-x.d.	+1/9	15	11*	4 17 9	56/5	37/3
Laurence, Scott	5/-	16/3	+2/6	12½	15	4 12 3	19/6	14/6
Lister, R. A.	£1	31/3	+1/3	9·3	10	6 8 0	40/-	28/9
London Elec. Wire	£1	52/3	+1/-	10	12½	4 15 9	61/3	50/6
Lucas, J.	£1	35/9	+1/6	7½	7½	4 4 0	56/6	38/9
Marryat & Scott	2/-	10/-	+3d	25	30	6 0 0	13/-	9/6
Mather & Platt	£1	57/-	+1/6	13·4*	15	5 5 3	75/-	48/-
Metal Industries	£1	17/3	+6d	9	9	—	38/-	25/-
Midland Elec. Mfg.	£1	46/3	+1/3	10	12½	5 8 0	55/-	44/-
Morphy-Richards	4/-	22/6		35	50	8 17 9	35/-	27/-
Murex	£1	67/-	+2/6	15	20	5 19 6	67/6	49/3
Newman Ind.	2/-	2/6x.d.	+3d	10	10	8 0 0	3/6	2/4
Oldham & Son	1/-	2/6		17½	20	—	3/6	2/1
Parnall (Yate)	5/-	8/6	+1/6	8	14	8 4 9	13/2	7/3
Parsons, C. A.	£1	82/6	+2/6	10	10	2 8 6	100/-	56/-
Plessey	10/-	73/9	+5/-	27½	30‡	4 1 3	89/-	55/-
Pye "A" Deferred	5/-	18/9	+1/9	20	12½*	3 6 9	32/9	14/3
Revo	10/-	11/-	+3d	9	9	8 3 6	15/6	12/6
Reyrolle	£1	107/6	+7/6	15	16½	3 0 6	127/6	89/-
Rheostatic	4/-	12/9		22½	18½*	—	14/3	9/3
Richardsons Westgarth	5/-	16/-	+1/-	15	16⅝	5 4 0	19/-	11/-
Scottish Cables	4/-	15/9		27½	27½	6 19 9	22/6	16/3
Smith (England), S.	4/-	14/-	+1/6	17½	17½	5 0 0	20/-	14/9
Southern Areas	£1	23/9		7½	10	8 8 6	38/-	27/6
Strand Elec.	5/-	7/9		17½	15*	9 13 6	13/3	7/6
Sturtevant	5/-	27/6	+1/3	18·9†	14·4*†	2 12 6†	35/9	21/-
Sun Elec.	£1	36/-		15	20	11 2 3	35/-	33/9
Switchgear & Cowans	5/-	14/9	+3d	20	25	8 9 6	17/-	11/-
Taylor Tunnicliff	5/-	12/-		15	15	6 5 0	16/3	11/3
T.C.C.	10/-	40/-		25	25	6 5 0	53/9	41/-
T.C. & M.	£1	30/-x.d.		8½	8½	5 13 3	40/9	29/3
Telephone Mfg.	5/-	7/-	+3d	10	10	7 2 9	11/6	7/9
Thorn Elec.	5/-	20/-	+2/-	20	15*	3 15 0	33/-	13/9
Thornycroft	£1	45/-	+2/6	15	15*	6 13 3	48/9	34/6
Tube Investments	£1	65/-	+5/-	22½	14*†	4 6 3	62/6	55/-
Vactric	5/-	14/3	+6d	10	15*	—	—	—
Veritys	5/-	7/9	+1/-	12½	12½	8 1 3	12/2	7/-
Walsall Conduits	4/-	12/-	+3d	70	70	—	17/3	12/-
Ward & Goldstone	5/-	33/9	+1/3	50	30*	4 9 0	45/-	32/6
Watford	2/-	6/9		25	25	—	8/9	6/3
Westinghouse Brake	£1	80/-	+2/6	18	18	4 10 0	110/-	82/-
West, Allen	5/-	14/-	+6d	15	15	5 7 3	16/6	8/-
Wolf Electric	5/-	19/-x.d.		20	20	5 5 3	26/3	16/1
Trusts, Transport and Communications								
Anglo-Am. Tel.: A. Ord.	100	75		6	6	8 0 0	88	67½
Ord.	100	50		3½	3½	7 10 0	54½	45
Anglo-Portuguese	£1	21/9	+6d	8	8	7 7 3	27/-	21/-
Brit. Elec. Traction: Def. Ord. "A"	5/-	19/-	+1/-	50	22½*	5 18 6	24/3	19/-
Cable & Wireless: Ord.	5/-	10/9	+3d	10	10	4 13 0	13/6	10/-
4% Loan	100	91		4	4	4 8 0	100	92/-
Calcutta Trams	£1	23/6		6†	7½†	6 7 9†	26/9	20/-
Cape Elec. Trams	£1	17/6	−1/3	5½	7½	8 11 6	19/6	16/6
Marconi Marine	£1	31/6		10	10	6 7 0	41/3	31/3
Oriental Tel. Ord.	1/-	80/-	−1/-	16	—	—	102/6	72/6
Telephone Rentals	5/-	11/-	+6d	10	12½	5 13 9	13/6	9/6

Canadian Electricity

Like British Columbia Power, the Shawinigan Water & Power Company has its shares quoted in London and is among the investments largely favoured by United Kingdom investors wanting a Canadian interest. Similarly also, the Shawinigan Company's annual report, now available, is a record of continued growth and expansion in the supply of power to the Province of Quebec. Revenue from power sales went up by nearly 13 per cent during the year, and total earnings rose from the equivalent of $2.91 to $3.48 per common share. In line with most Canadian stocks, the common shares stand near their all-time peak at $140. They show a yield of about 2½ per cent on the basis of an indicated dividend of $1.60 per share.

Dividends Declared

Allen West and Chloride Electrical Storage are both maintaining dividends for the past year at the same rates as before from moderately higher net profits. The former's 15 per cent comes as a single annual payment on the one-class £1,755,000 ordinary capital, and involves the distribution of rather more than one-third of the net surplus of £455,000. Chloride Electrical's final payment (declared as a second interim) makes a total of 17½ per cent, which absorbs a similar proportion of the available surplus. Shares of both were quoted a little higher. Laurence, Scott & Electromotor rose 2s 6d to 15s 9d on the company's decision to add a 2½ per cent bonus to the 15 per cent dividend. With earnings again well up, the distribution still has an exceptionally conservative character. Newman Industries improved to 2s 6d xd. after the results.

British Oxygen

Allotment letters were due to go out yesterday (Thursday) to British Oxygen shareholders, giving effect to the one-for-two scrip issue. The company has declared for 1954–5 a final dividend making a total of 15 per cent (as on the three previous occasions) and intends to adjust the rate of future payments in relation to the increase in capital. The last distribution applied to capital increased by the rights issue which raised over £8 million of new money last summer for development purposes. Earlier this year the market in the shares appeared to be affected by a private placing of 600,000 shares by Metal Industries (which retain a holding of a million) as part of that company's re-financing arrangements. At 59s 6d the £1 shares, show a yield of just over 5 per cent.

REPORTS and DIVIDENDS

The Brush Group, Ltd.—The annual meeting will be held on 17th May. In his statement circulated with the report and accounts, Sir Ronald Matthews (chairman) says that they held their position in 1955 in spite of increasing competition from abroad and sharply rising prices at home, coupled with severe dislocation through the dock strike. Output has been well maintained in the group, the order book has continued to show an encouraging trend and they have maintained their position in the export market though it has been necessary to offer extended credit facilities to many important customers. Output and exports would have been even more satisfactory if their suppliers had been able to maintain the promised delivery dates. A concerted effort, for which the utmost support of suppliers was essential, is needed if the volume of export trade is to be maintained.

Reviewing the group's activities, Sir Ronald says that the Brush Electrical Engineering Co., Ltd., has considerably extended its facilities for research and development. A light-weight alternator has been developed which embodies new concepts in electrical machine design and construction, and a new system of voltage control has been invented which enables static equipment to be used instead of rotating machinery. Production was started on a new line of turbo-superchargers for diesel engines and progress has been made with transformer tap-changing gear and a full range of equipment is in production. The range of circuit-breakers and distribution switchgear has been extended and the testing facilities for switchgear and transformers have been increased.

The most significant order received by Brush Traction, Ltd., is for twenty main line diesel-electric locomotives for the British Transport Commission. The general engineering division has successfully negotiated a number of large contracts during the year, including a substantial order for the electrification of six towns and 130 villages in Iran.

F. Perkins, Ltd.—In his review of 1955, Mr. F. A. Perkins (chairman and managing director) says that the turnover at nearly £20 million shows an increase of 18 per cent over 1954. During the year £666,708 was spent on fixed assets and with further calls on the cash resources to finance an increase in stocks and trade debtors, the cash in hand at the end of the year was £574,103 less than a year ago. With capital commitments of £729,000 it will be necessary to raise additional finance in the near future, and the board is giving considerable thought to this problem. The factory extension is now nearing completion and some part of the machine tools are installed and are in operation. The reduction in profit as compared with the previous year is largely due to heavy expenses incurred in developing the R6 engine. The order book continues to increase in line with the increased turnover and there has been a spreading of both customers and applications.

British Insulated Callender's Cables, Ltd.—A sharp rise in profits is reported for 1955. The profit on trading was £11,852,852, as compared with £7,379,205 for the preceding year, to which is added income from other sources, making £12,357,170. After meeting all charges, including £4,839,058 for taxation, the group net profit is £5,128,161 (against £3,206,454), of which £4,501,532 is attributable to the holding company. Capital reserves receive £87,740 and revenue reserves £2,550,638. It is proposed to pay a final ordinary dividend of 8½ per cent on capital of £15,000,000 (against 7½ per cent on £12,350,000). An interim dividend of 4 per cent (against 2½ per cent) was paid on the smaller capital. The 1954 dividend was 10 per cent, and in addition there was a special distribution of 2½ per cent from realised capital profits not taxable. The increase in the balance carried forward is £780,717.

The National Electric Construction Co., Ltd.—The group net profit for 1955, after tax provision of £89,338, is £101,416, as compared with £94,949 for 1954, of which £88,987 is attributable to the parent company, and after retentions in subsidiaries, the parent company's net profit is £83,552. The dividend for the year is 17½ per cent (against 15 per cent).

The Chloride Electrical Storage Co., Ltd.—Net profits of £1,102,083 are reported for 1955, as compared with £1,039,087 for the previous year. United Kingdom taxation absorbed £1,175,247 and other taxation £97,927. It is proposed to pay a second interim dividend, in lieu of a final dividend, of 12½ per cent, making 17½ per cent for the year (unchanged).

Glenfield & Kennedy Holdings, Ltd., reports group profits for 1955 of £1,246,957, as compared with £1,393,616 for the preceding year, and after tax provision, the net balance is £656,370 (against £647,961). It is proposed to pay a final ordinary dividend of 15 per cent, maintaining the distribution for the year at 20 per cent. The balance carried forward is £182,898 (against £168,970 brought in).

Newman Industries, Ltd., reports a trading profit for 1955 of £231,866, as compared with £185,699 for the preceding year, and after providing for depreciation, etc., and £68,250 for taxation, the net profit is £51,972 (against £26,494). It is proposed to pay an ordinary dividend for the year of 10 per cent (unchanged) and also to repeat the dividend of 8 per cent on the 6 per cent participating preferred ordinary capital. The balance carried forward is £146,308 against £111,554 brought in).

Hopkinsons, Ltd., report profits for the year to 31st January last of £876,541, as compared with £940,484 for the previous year, and after providing £421,000 for taxation, the net balance is £455,541 (against £483,484). General reserve receives £300,000 and investment reserve £12,300. It is proposed to pay a final dividend of 17½ per cent (15 per cent), making 27½ per cent for the year on £700,000 ordinary capital (25 per cent). The balance carried forward is £570,443 (against £551,977 brought in).

Elliott Brothers (London), Ltd.—After providing £115,000 for taxation, the net profit for 1955 is £145,685, as compared with £107,878 for 1954. It is proposed to pay a final ordinary dividend of 12½ per cent, making 17½ per cent on £540,000 capital. For the previous year the interim dividend was 7 per cent on £308,000 and the final dividend 12 per cent on £462,000 capital.

Laurence, Scott & Electromotors, Ltd.—Profits for 1955, before taxation, were £736,219, as compared with £605,323 for 1954. Taxation absorbs £377,000, and the net profit is £359,219 (against £298,323). The dividend for the year is maintained at 12½ per cent, and in addition a bonus of 2½ per cent is paid.

Allen West & Co., Ltd., report that after providing £408,967 for taxation, the group profit for the year to 31st January last is £455,400, as compared with £426,081 for the previous year. The amount attributable to the holding company is £454,741. General reserve receives £257,921 and the dividend for the year is unchanged at 15 per cent.

The Harland Engineering Co., Ltd.—The group net profit for 1955 is £96,235, as compared with £108,148 for 1954. General reserve receives £50,000 and plant replacement reserve £50,000. The dividend for the year is unchanged at 14 per cent, with a final distribution of 10 per cent. The balance carried forward is £61,494 (against £53,567 brought in).

The Watford Electric & Manufacturing Co., Ltd., reports that after deducting taxation, the net profit for 1955 is £50,199, as compared with £48,016 for 1954. It is proposed to pay a final dividend of 10 per cent and a bonus of 10 per cent, making 35 per cent for the year. A similar distribution was made for 1954 but on smaller capital.

Thomas Bolton & Sons, Ltd.—In his circulated statement, Mr. P. V. Hunter (chairman) says that practically all sections of their manufacturing

(*Continued on page 697*)

FINANCIAL SECTION (*continued*)

operations have been fully engaged up to the limits of available labour, and the overall tonnage output is considerably up on the previous year. Direct exports during the year were of the order of £1½ million. Copper prices have again fluctuated to an unpredictable extent and the levels reached have far exceeded those attained in 1954. A drastic reduction and greater stability in price is urgently needed if the whole copper industry is not to be threatened with still further inroads by substitute materials.

Blaw Knox, Ltd.—In his circulated statement issued with the report and accounts for 1955, Mr. J. M. Wallace (chairman) says that despite severe competition the business in all directions has held up remarkably well, the volume of orders on hand being satisfactory, not only with the Construction Machinery Department, but also with the Tower Department which has the largest volume of orders on hand in its history. Orders for transmission towers for both home and overseas are still expanding. The difficulties in the steel supply position continue to be a matter for serious concern, and the easing of the steel supply situation would have an important influence on their ability to expand still further their overseas business.

W. Canning & Co., Ltd.—The net profit for 1955, after deducting £373,531 for taxation, is £276,931, as compared with £260,276 for 1954. General reserve receives £100,000 and contingencies reserve £50,000. It is proposed to maintain the dividend for the year at 25 per cent by a final payment of 20 per cent.

The Electrical Apparatus Co., Ltd., has declared an interim dividend of 7½ per cent (unchanged).

Radio Rentals, Ltd., is paying an interim dividend of 10 per cent (same). This and the previous final dividend are on increased capital.

The British Electric Resistance Co., Ltd., has announced an interim dividend of 5 per cent (unchanged).

Contactor Switchgear, Ltd., has declared an interim dividend of 6 per cent (unchanged).

New Companies

Richardsons Westgarth Atomic, Ltd.—Registered 9th April. Capital £250,000. To carry on the business of physicists, metallurgists and chemical, electronic, mechanical and electrical engineers, and to design and manufacture nuclear reactors and all types of apparatus and equipment for the generation of power from atomic energy, etc. Directors: H. Fothergill, O. J. Philipson and J. R. Mackay (all directors of Richardsons Westgarth & Co., Ltd.). Solicitors: Wilkinson & Marshall, Newcastle-on-Tyne.

Power Reactors, Ltd.—Registered 7th April. Capital £1,000. To design and construct power stations and installations, including atomic power stations, nuclear reactors and atomic plant, etc. Solicitors: Holmes, Son & Pott, 3, London Wall Buildings, E.C.2.

Frig. Elec. (Services), Ltd.—Registered 17th March. Capital £100. Electrical equipment specialists, etc. Regd. office: 135, Perry Hill Road, Quinton, Birmingham, 32.

Surrey Home Appliances, Ltd.—Registered 3rd February. Capital £10,000. Electricians, radio and television engineers, electrical and mechanical engineers, etc. Directors: G. E. Berridge, L. J. Berridge, E. G. Berridge and Mrs. Minnie A. Berridge. Solicitors: A. R. Drummond & Co., Epsom.

Morbury Electricals, Ltd.—Registered 17th February. Capital £100. Electricians, electrical contractors, etc. Directors: C. A. Morgan, Mrs. Helena M. Morgan and Miss Elvira Evans. Regd. office: 1, Heol Gledyr, Caerphilly, Glam.

Aceville Electric, Ltd.—Registered 17th February. Capital £100. Electrical engineers and contractors, manufacturers of and dealers in radio apparatus, etc. Regd. office: 156, Strand, W.C.2.

Wallace Electrical Services (Fiat Lux), Ltd.—Registered 13th February. Capital £100. Electrical equipment specialists, etc. Directors: F. P. Wallace, Mrs. Joan E. Wallace and P. I. Roach. Regd. office: 3, The Green, Wonersh, nr. Guildford, Surrey.

Portway Electrical Services, Ltd.—Registered 15th February. Capital £1,000. Electrical and mechanical engineers and contractors, etc. Directors: K. R. Brooks, W. Robson and J. Wood. Regd. office: 48, Davis Street, Avonmouth, Bristol.

Modern Electrical Services (Bristol), Ltd.—Registered 4th February. Capital £1,000. Electrical engineers and general electrical installation contractors, etc. Regd. office: 21, Lawrence Hill, Bristol, 5.

A. & J. Edmonds, Ltd.—Registered 3rd February. Capital £100. Electrical, radio and television engineers, etc. Directors: A. W. C. Edmonds and Mrs. Joyce E. Edmonds. Regd. office: 84, Frederick Road, Cheam, Surrey.

Bankruptcies

A. C. Payne, residing and formerly carrying on business at 40, Springfield Road, Wickersley, Rotherham, as electrical contractor.—Order made 15th March suspending bankrupt's discharge for two years until 15th March, 1958.

V. F. Pitt, electrical engineer, 54, Mortimer Street, Herne Bay.—Trustee, Mr. J. S. Bradley-Hole, 7, Old Steine, Brighton, 1, appointed 12th April.

E. T. M. Marshall, formerly carrying on business at High Street, Hurstpierpoint, Sussex, under the style of G.E.M. Radio Electric, as a radio and electrical dealer.—First and final dividend of 2s 4d in the £, payable on and after 27th April at the Official Receiver's Office, 8, Old Steine, Brighton, 1.

A. J. L. Fleming, 54, Fore Street, Buckfastleigh, Devon, electrical engineer.—Receiving order made 4th April on debtor's own petition. Public examination 11th May at 4, Elliot Street, The Hoe, Plymouth.

Need to Increase Productive Manpower

Industry must give a much clearer indication of its educational requirements, said Mr. O. W. Humphreys (director in charge of research, General Electric Co., Ltd.) in an address at the annual luncheon of the Liverpool Centre of the Illuminating Engineering Society. Mr. Humphreys said there must be closer co-operation between the Ministry of Education, the universities, technical colleges and industry and particularly between those who trained technicians and those who used them. If industry did not say what it wanted then it must accept responsibility for not getting what it required. This country could not overcome its present difficulties until it increased the ratio between what a man produced and what he used. They must transfer people from non-creative work to creative work. Transport, handling and retail distribution did not yield anything in the form of products.

Industry had contributed £2,900,000 towards improving facilities for teaching science in schools and it was hoped to raise a total of £3,500,000. That was enough to make an impression on the problem. Steps had to be taken to make the teaching of science more attractive and the selection of headmasters should include a bigger proportion of scientists. The tendency to over-educate must be stopped for it was a mistake to try to turn the good technician into a poor scientist.

Universities must look to their laurels or their functions would be usurped by technical colleges, which were alive and aware of the responsibility to give industry what it wanted. Sandwich courses, though not in all cases ideal, showed willingness to tackle the problems.

The luncheon was attended by about 120 people, including the president of the I.E.S. (Mr. A. G. Higgins) who proposed the toast to the "City and Port of Liverpool," the deputy Lord Mayor (Ald. A. Griffin) responding.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 2nd May from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1948

18408. Schultz Die Casting Co.—Electronic control for die casting machines. 8th July, 1948. (748431.)

1950

28046. Standard Telephones & Cables, Ltd.—A.c. switching devices comprising gas-discharge tubes. 9th November, 1951. (748482.)

1951

19041. Schultz Die Casting Co., and Triggs, W. W. (Schultz Die Casting Co.).—Supply circuits for discharge tubes. 8th July, 1948. (748432.)

20603. Standard Telephones & Cables, Ltd.—Electromagnetically driven counter. 31st August, 1951. (748542.)

29965. Method X Co.—Spark cutting apparatus for electrically eroding a workpiece. 21st December, 1951. (748543.)

1952

8818. Method X Co.—Apparatus for cutting materials by electric sparks. 7th April, 1952. (748544.)

19063. National Research Development Corporation.—Electrical calculating circuits employing transistors. 13th July, 1953. (748546.)

20252. Western Electric Co., Inc.—Electric signal translating devices utilising semiconductive bodies. 12th August, 1952. (748487.)

27222. General Electric Co., Ltd., Cross, F. D., and Johnson, M. P.—Apparatus for regulating electric signals. 18th January, 1954. (748550.)

29957. General Electric Co., Ltd., and Bryer, R. F.—Control means for fluid pressure systems. 25th November, 1953. (748492.)

1953

2375. Young, S. G.—Electric socket connectors. 25th January, 1954. (748495.)

7367. General Electric Co., Ltd., and Shaylor, J. H.—Electric discharge devices. 17th March, 1954. (748408.)

9819. Telefonaktiebolaget L. M. Ericsson.—Devices for the amplification of electrical signals and having automatic gain control. 10th April, 1953. (748500.)

9837. British Thermostat Co., Ltd.—Snap-action thermally responsive switch devices. 9th April, 1954. (748556.)

10922. Morphy-Richards, Ltd.—Thermally operated electrical circuit-breaking device. 21st April, 1954. (748501.)

12541. Jelson Electric, Ltd., and Moulson, J. P.—Push button electric switch mechanism. 6th July, 1954. (748354.)

12842. Whipp & Bourne, Ltd., and Whipp, I. T. L.—Electric switchgear and arc interrupting devices therefor. 15th July, 1954. (748355.)

14872. Plessey Co., Ltd.—Flexible electric conductors for loudspeakers. 21st May, 1954. (748559.)

15619. Napier & Son, Ltd., D.—Fixed capacity electrical condensers. 1st June, 1954. (748560.)

15809. Foster Transformers, Ltd., and Jennings, R. E.—Method of and apparatus for earth resistance testing. 4th June, 1954. (748458.)

16230. Western Electric Co., Inc.—Semiconductor signal translating elements and devices utilising them. 12th June, 1953. (748414.)

16575. Kent, Ltd., G.—Glass electrodes. 10th June, 1954. (748506.)

16897. Metropolitan-Vickers Electrical Co., Ltd.—Electronic pulse modulator apparatus. 6th May, 1954. (748508.)

16929. National Research Development Corporation.—Circuits for current measurements. 14th June, 1954. (748415.)

18381. Bendix Aviation Corporation.—Electrically controlled switching device. 2nd July, 1953. (748561.)

19074. Siemens & Halske Akt.-Ges.—Selecting mechanism for printing telegraph receivers. 9th July, 1953. (748416.)

19827. Electric & Musical Industries, Ltd.—Circuit arrangements for generating sawtooth currents. 8th July, 1954. (748460.)

22120. National Research Development Corporation.—Electrical devices using the Johnson-Rahbek effect. 11th August, 1954. (748461.)

23993. Siemens-Schuckert (Great Britain) Ltd.—Remote control of electric lighting installations. 31st August, 1954. (748569.)

24247. Lucas (Industries), Ltd., J.—Electric switches. 3rd August, 1954. (748517.)

28058. General Electric Co., Ltd., and Mounsdon, M. H.—Levelling devices for lanterns. 12th October, 1954. (748380.)

28440. Telefunken Ges.—Circuit arrangements for generating sawtooth currents. 15th October, 1953. (748429.)

28572. Hoover, Ltd.—Vacuum cleaners. 16th October, 1953. (748574.)

28806. Collier, R.—Thermally responsive electric heat regulating switch. 22nd April, 1954. (748575.)

29680. Alexander, D. B., Bourke, E. R., Chamberlain, H. T., Mannion, J. F., Schneider, E. W., Wade, W. A., Vrtis, C. S., and Gary, L. J.—Two-piece separable electrical connector. 27th October, 1953. (748382.)

33277. Marconi's Wireless Telegraph Co., Ltd.—Ultrasonic delay devices. 15th October, 1954. (748438.)

35782. General Electric Co.—Transmission systems. 23rd December, 1953. (748447.)

1954

134. Chicago Bridge & Iron Co.—Process of electric arc welding. 4th January, 1954. (748531.)

3950. FKG F. Kesselring Geratebau Akt.-Ges.—Arrangements for limiting overload currents in d.c. and a.c. supply systems. 10th February, 1954. (748532.)

12567. Schultz Die Casting Co.—Electrical controlling system. 18th May, 1953. (748449.)

29660. Pandapas, G. J.—Element of mechanism for conducting electricity between relatively movable members. 14th October, 1954. (748480.)

30080. Accumulatorenfabriek Varta N.V.—Separator for electric accumulators. 19th October, 1954. (748538.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 11th May:—

PYECOM. No. 741,062. Class 9. Scientific, radar, signalling, navigational, radio, television and telecommunication apparatus and instruments; domestic electrical appliances and electrical, acoustical and electronic apparatus and instruments; electric batteries, accumulators, gramophones, microphones, amplifiers, loudspeakers, etc.; electric oscillation generators, germanium diodes, transistors and fittings.—Pye, Ltd., Radio Works, St. Andrews Road, Cambridge.

M E C (design). No. 743,633. Class 9. Electric accumulators, batteries, ammeters, ignition coils, commutators, condensers, cut-outs, connectors, distributors, lenses, liquid gauges, junction boxes, switches, insulated electric wire, cables; radio, television, telegraphic and telephonic apparatus and instruments, etc.—Motor & Electronics Corporation, Ltd., 31-32, Alfred Place, London, W.C.1.

WEBATRON. No. 749,039. TRAKATRON. No. 749,040. Class 9. Apparatus employing photo-electric scanning devices for use in controlling the operation of machines, and parts.—J. F. Crosfield, Ltd., 2, Elthorne Road, London, N.19.

MULTIDICT. No. 749,778. Class 9. Apparatus for controlling the operation of dictating machines by means of electric current control.—G.B. Equipments, Ltd., 37-41, Mortimer Street, London, W.1.

LUMIFLECTOR. No. 745,399. Class 11. Lighting installations and parts.—Holophane, Ltd., Holophane House, Elverton Street, Vincent Square, London, S.W.1.

PERMAGLASS. No. 748,164. PERMAFIBER. No. 748,450. Class 11. Industrial chemical installations, and parts of installations for lighting, heating, steam generating, cooking, refrigerating, drying, ventilating, water supply and sanitary purpose, all being made of glass fibre bonded with synthetic resin.—Permali, Ltd., 125, Bristol Road, Gloucester.

CATALOGUES AND LISTS

DOMESTIC EQUIPMENT. — 16-page "Spring Brochure" giving particulars of water heaters, refrigerators, small fans and other appliances sold by the company.—**London Electrical Co. (Blackfriars), Ltd.,** Blackfriars Road, London, S.E.1.

DRILL.—Descriptive folder dealing with the "Manco" free spiral masonry drill for brick, stone, concrete, tiles, etc.—**Manco, Ltd.,** Camp Lane, Kings Norton, Birmingham, 30.

DUST CONTROL.—72-page illustrated publication (2004) entitled "Dust Characteristics, Problems and Control".—**Sturtevant Engineering Co., Ltd.,** Southern House, Cannon Street, London, E.C.4.

LAMPS.—Folder dealing with the company's new "Softlight" pink tinted lamp.—**Ekco-Ensign Electric, Ltd.,** 45, Essex Street, London, W.C.2.

LIGHTING FITTINGS.—Folder containing illustrations of the company's decorative wrought iron lighting fittings.—**Raejon Industries, Ltd.,** 1a, Portersfield Road, Norwich.

Illustrated and priced 45-page catalogue covering lighting fittings of various types which are sold by the company.—**Rich & Pattison (Birmingham), Ltd.,** 81, Jamaica Row, Birmingham, 5.

Abridged catalogue (55/2) describing briefly the range of Holophane commercial, industrial and street lighting units suitable for overseas markets, and brochures describing the "Lumifractor" street lighting lantern and single-piece dome and bowl refractors.—**Holophane, Ltd.,** Elverton Street, London, S.W.1.

MOTOR CONTROL GEAR.—Descriptive 36-page catalogue of motor control gear now available.—**Square D, Ltd.,** 100, Aldersgate Street, London, E.C.1.

PLUGS AND SOCKETS.—Catalogue (935) giving prices and particulars of the "Easigo" range of metalclad protected type plugs and sockets.—**A. Reyrolle & Co., Ltd.,** Hebburn, Co. Durham.

REFRIGERATORS.—Folders describing the recently introduced Prestcold "Six" and automatic "Eight" refrigerators.—**Pressed Steel Co., Ltd.,** Cowley, Oxford.

STAIRCASE SWITCHES.—Leaflet (15) dealing with the type ST2 staircase time switch.—**Venner, Ltd.,** Kingston By-Pass, New Malden, Surrey.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—4th May. Brisbane City Council. 300 lightning arresters. (E.S.B. 10127/56. Ten/18963.)*

7th June. Director, Posts and Telegraphs, G.P.O., Melbourne. Cord type switchboards. (E.S.B. 9579/56. Ten/18880.)*

28th June. Commonwealth of Australia, Department of Supply. H.f. induction heating power supply equipment. (E.S.B. 9821/56. Ten/18977.)*

Birmingham.—16th May. Public Works Committee. Street lighting equipment. (See this issue.)

Burma.—4th May. Union Purchase Board. Nine electrically driven centrifugal pumps. (E.S.B. 9911/56. Ten/18922.)*

Canada.—9th May. Manitoba Hydro-Electric Board. 600 V motor control and load centres for Brandon generating station. (E.S.B. 9644/56. Ten/18956.)*

15th May. British Columbia Power Commission. 37,500 kVA power transformer for the Upper Campbell Lake Development. (E.S.B. 10438/56. Ten/19024.)*

Carlisle.—4th May. City Council. Street lighting equipment for the Harraby neighbourhood unit. 9th May. Electrical installation in the City Hall. L. J. A. Stow, city engineer, 18, Fisher Street.

Durham.—County Council. Electrical installations at Bloemfontein Modern School and Consett (C.E.) Controlled School. G. R. Clayton, county architect, South Street.

Greece.—10th May. State Procurements Service, Ministry of Finance. Electric cables. (E.S.B. 9657/56. Ten/18892.)* 24th May. Underground cables. (E.S.B. 10276/56. Ten/18974.)*

30th May. Two 30 kVA and four 50 kVA diesel generator sets. (E.S.B. 9774/56. Ten/18938.)*

India.—10th May. Director General of Supplies and Disposals. Covered copper wire and nichrome resistance wire. (E.S.B. 10292/56. Ten/18998.)*

15th May. Government of Madras. Lightning arresters. (E.S.B. 9987/56. Ten/18930.)*

25th June. Damodar Valley Corporation Electricity Department. Condensers, feed water heaters, evaporators and de-aerators. (E.S.B. 10058/56. Ten/18968.)*

Iraq.—10th May. Director General of Post and Telegraph. Copper and iron wires. (E.S.B. 10053/56. Ten/18976.)*

London.—15th June. India Store Department. Polyphase meter testing equipment and relay boards for demonstration for an engineering college. (See this issue.)

Manchester.—16th May. City Council. Street lighting equipment. (See this issue.)

Mitcham.—5th May. Borough Council. Street lighting equipment. (See this issue.)

Newcastle-on-Tyne.—Education Committee. Electrical installation in the new Rutherford High School. City architect, 18, Cloth Market, Newcastle-on-Tyne.

Rhodesia and Nyasaland.—11th May. Ministry of Posts. 1,000 cable distribution boxes. (E.S.B. 10077/56. Ten/18964.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

South Africa.—Firms wishing to be included in the proposed list of approved tenderers for carbon electrode moulded protectors should apply to the Controller of Post Office Stores, P.O. Box 447, Pretoria. (E.S.B. 9975/56. Ten/2738.)*

10th May. Union Tender and Supplies Board. 250 portable magneto telephones. (E.S.B. 9876/56. Ten/18934.)*

17th May. Radio valves. (E.S.B. 9871 and 9870/56. Ten/18913 and 18914.)*

Southern Rhodesia.—22nd May. City of Salisbury. Electricity meters. (E.S.B. 9949/56. Ten/18928.)*

6th June. City of Bulawayo. 73 three-phase power and two earthing transformers. (E.S.B. 9895/56. Ten/18929.)*

Syria.—10th May. Municipality of Hassake. Creosoted wood poles, cable, insulators and fittings. (E.S.B. 10223/56. Ten/18996.)* 250 kVA transformers. (E.S.B. 10221/56. Ten/19000.)*

Thailand.—3rd May. Telephone Organisation of Thailand, Bangkok. Twisted drop wire and desk telephones. (E.S.B. 9992/56. Ten/18970.)*

Turkey.—30th May. H.Q. Command, Office of the Purchasing and Contracting Officer, Allied Land Forces, Izmir. 34 electric desk and wall fans. (E.S.B. 10202/56. Ten/18980.)*

ORDERS PLACED

Derby.—Sheffield Regional Hospital Board. Recommended. Electrical work at central laundry of the Manor Hospital, Derby (£3,046).—Battersby & Hefford.

London.—County Education Committee. Renewal and improvement of electrical installations in schools:—Falconbrook County Primary, Battersea North (£3,027) and similar work at the Pitfield County Secondary, Shoreditch and Finsbury (£3,629).—Buchanan & Curwen. Wandsworth County Secondary (£3,800).—Powerlite Electrical Installations. George Green's School, Poplar (£3,486).—Charing Cross Electrical Installation Co. Reay County Primary (£2,589) and Lancaster County Primary and Secondary, Kensington North (£3,310).—Rider Electrical Co. Redman County Primary, Stepney (£3,009) and William Tyndale County Primary, Islington South West (£3,374).—Electrical Contracting Co. Fulham County Secondary (£5,200).—H. A. Lamb & Sons. Saunders Grove County Primary, Hammersmith North (£3,699).—Beaufort Electrical Engineering Co. Beaufoy County Secondary, Lambeth (£3,575).—H. A. Lamb & Sons. Edward Wilson County Primary, Paddington South (£3,865).—Thorpe & Thorpe.

Market Drayton.—Birmingham Regional Hospital Board. Recommended. Renewal of the electrical installation, etc., at Cottage Hospital, Market Drayton (£1,398).—G. H. Smallwood & Co.

Newcastle-on-Tyne.—Regional Hospital Board. Electrical installation work: Department of neurological surgery, Newcastle General Hospital (£5,097).—Robson & Coleman. Outpatients' department, Sunderland General Hospital (£1,399).—F. Reid Ferens & Co. Villa at Prudhoe and Monkton Hospital (£1,245).—T. G. Usher. "East Riding," St. George's Hospital (£948).—A. Hagerty.

Ryton-on-Tyne.—U.D.C. Electrical installations in 48 houses at Woodside Way, Ryton.—W. Hinton, Blaydon.

Woodbridge (Suffolk).—East Anglian Regional Hospital Board. Recommended. Electrical services for occupational therapy unit (£1,308) and sewing room unit (£780) at St. Audry's Hospital, Melton.—P. H. Allin & Sons.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Aldridge.—Flats (28), Pheasey estate; U.D.C. surveyor.

Ashburton.—County secondary school (£123,660); Devon county architect, 97, Heavitree Road, Exeter.

Ashford.—Canning factory, Willesborough, for Batchelors Peas, Ltd.; Christiani & Nielsen, Ltd., contractors, Romney House, Marsham Street, London, S.W.1.

Barnard Castle.—County grammar/technical school; county architect, Durham.

Birkenhead.—Reconstruction of Little Theatre; Little Theatre Co., Grange Road West.

Blaydon-on-Tyne.—R.C. church, hall and presbytery at Winlaton; R. Burke, architect, Lambton Road, Newcastle-on-Tyne.

Boscombe.—Ice cream factory with cold rooms, etc.; Bournemouth Ice Cream Co., Ltd., 57, Palmerston Road.

Bradford.—Factory, Parry Lane, for J. L. Tankard and Co., Ltd., rug manufacturers, Swaine Green Works, Laisterdale; William Illingworth & Sons, architects, 15, Sunbridge Road.

Bristol.—Seven-storey building, Wine Street-Pithay area; Cotton, Ballard & Blow, architects, Cavendish House, Waterloo Street, Birmingham, 2.

Offices, Queen Square and Prince Street; Alec F. French & Partners, architects, Halifax House.

Burton-on-Trent.—30-acre housing estate, Mill Hill Lane; Gnu House Co., Ltd., St. Stephens Chambers, Telegraph Street, London, E.C.2.

Chester.—Permanent buildings at The Roodee for Chester Race Co., Ltd.; Saxon Smith & Partners, architects, 2, Stanley Street.

Crawley.—Dwellings (780), Tilgate area; Crawley Development Corporation, Broadfield Offices.

Croydon.—Self-service store, High Street; Premier Supermarkets, Ltd., 35, George Street, Richmond, Surrey.

Dunfermline.—Houses (115), Aberdour Road; Scottish Special Housing Association, Ltd., 15-21, Palmerston Place, Edinburgh.

Durham.—Modern school at Ushaw Moor (£150,000); G. M. Pearson & Son, Ltd., builders, Hetton.

Secondary modern school at Kepier; county architect, South Street, Durham.

Elstree.—Dwellings (53), Brook Road estate; council surveyor.

Exeter.—Arts building for University College of South West; Sir Wm. Holford & Partners, architects, 2, Angel Court, London, E.C.2.

Felling (Co. Durham).—Shops (23), Leam Lane estate for Ravenseft Properties, Ltd.; L. H. Fewster & Partners, architects, 22, Conduit Street, London, W.1.

Six blocks of three-storey flats at Leam Lane for the U.D.C. (£141,000); John Clark & Son, builders, Gregson Terrace, Seaham.

Gateshead.—Factories and offices; Clyde, Crane & Booth, Ltd.

Glasgow.—Offices, Holmfauld Road; Alexander Stephen & Sons, Ltd., Linthouse Shipyard.

Works extensions for John Allan & Sons, Ltd., Sword Street; Wm. Guthrie & Co., Ltd., builders, 10, Vernon Street.

Guisborough.—Modern school (£213,000); G. Dougill & Sons, builders, Chestnut Street, Darlington.

Fire and ambulance stations; county architect, North Riding County Hall, Northallerton.

Hartlepool.—Modern school at West View for Durham C.C. (£93,000); G. M. Pearson & Son, builders, Front Street, Hetton.

Hartley Wintney (Hants).—Houses (45), Penkridge Street estate, Crondall; P. J. Mitchell, R.D.C. surveyor.

Hexham.—Houses (50) at Corbridge for the C.C.; W. Dixon & Sons, 1, Collingwood Street, Newcastle-on-Tyne.

Heywood.—Houses (96), Hardfield site; borough surveyor.

Hindley.—Houses (84) at Wooddagger estate; W. Grimes, U.D.C. surveyor.

Huntingdon.—Rewiring of county hospital (£3,750); Hospital Committee.

Jarrow.—Factory additions, Bede Trading estate, for Morganite Resistors, Ltd.; George Henderson, contractor, East Boldon, Co. Durham

Kirkcaldy.—Flats (48), Muttonhall estate; burough surveyor.

Knapton (Yorks).—Grain maltings for Associated British Maltsters, Ltd.; Wm. Thornton & Sons, Ltd., 38, Wellington Road, Liverpool.

Leamington Spa.—Bus station, etc., Approach Road; C. O. Innes-Jones, borough surveyor, Town Hall.

Leeds.—Shops (12) and maisonnettes, Seacroft estate; N. B. Bell & Co., Ltd., Frankland Terrace.

Leicester.—Old people's home in Barclay Street; city architect.

London.—National film theatre proposed at the Waterloo Bridge site; Dr. J. L. Martin, L.C.C. Architects' Department, County Hall, Westminster Bridge, S.E.1.

Office block, Old Broad Street, City; Galbraith Bros., Ltd., builders, 61, Bartholomew Close, E.C.1.

New wing, Grosvenor House, Park Lane; Gordon Jeeves, architect, 61, Catherine Place, S.W.1.

School, Belmont Avenue, Tottenham; borough engineer.

Dwellings (215), Major Road, West Ham; A. E. Symes, Ltd., builders, 1a, Carpenters Road, E.15.

Long Handborough (Oxon).—Factory for John Bruce (Engineering), Ltd., Eynsham; F. Russell Cox, architects, Blanket Hall, Witney, and High Street, Burford.

Loughborough.—First phase of College of Technology for Leics E.C.; H. Mounteneay & Son, Ltd., 12, Nottingham Road, Leicester.

Malton (Yorks).—Modern school for North Riding E.C. (£147,000); William Birch & Sons, Ltd., builders, Spen Lane, York.

Manchester.—Factory and offices at Shentonfield Road, Wythenshawe, for Hilson Wire Products; Arthur Wardle, Ltd., 30, Alberton Street.

Margate.—Flats (86) and shops (10), Zion Place area; borough engineer.

Milford Haven.—Houses (77), Gelliswick, for U.D.C.; Gibson & King, contractors, Great North Road, Milford Haven.

Newbury.—Houses (40), Bath Road estate; E. H. Hutton, borough surveyor, Municipal Buildings.

Newcastle-on-Tyne. — Technical school (£200,000); L. J. Couves & Partners, Carliol House.

Rutherford High School for Girls for the E.C. (£240,000); Harry Kindred, Ltd., builders, 371, West Road.

Art institute, Queen's Road, for King's College; W. B. Edwards & Partners, Eldon Place.

Hotel on Coast Road, James Deuchar & Co.; R. W. Bell & Son, Mistletoe Road.

North Riding.—Primary school at Osbaldwick; J. H. Napper, architect, 56, Eldon Place, Newcastle-on-Tyne.

North Shields.—Factory for the British Die Casting Co., Ltd.; Hastie D. Burton, Ltd., builders, King Street.

Nottingham.—Buildings for People's College of Further Education in Walnut Tree Lane (£426,900); R. M. Finch, city surveyor, Guildhall.

Northallerton.—Modern school for North Riding E.C.; D. C. Hall, architect, 6, Masons Yard, Duke Street, London, S.W.1.

Oxford.—Additional galleries at Ashmolean Museum; Easton & Robertson, architects, 53, Bedford Square, W.C.1.

Peterlee.—Technical college, community centre, fire station, police station and hospital; county architect, Durham.

Plymouth.—Shops (4) and flats (16), Honicknowle Green; Town & Country Building Co., Ltd., Chaucer Way.

Rickmansworth. — Factory and offices, Town Wharf; Aaronson Bros., Ltd., 332, Old Street, London, E.C.1.

Rothwell.—Houses (50), Wood Lane; Harlow & Milner, Ltd., Warrengate, Wakefield.

South Shields.—Bungalows (88) at Whiteleas estate; John Reid, borough engineer.

Stamford.—Houses (42), Drift Road estate; F. J. Lenton & Partners, architects to Council, 16, Broad Street.

Stevenage.—Girls' grammar school, Ashtree Wood (£168,000); C. H. Aslin, county architect, County Hall, Hertford.

Stockton-on-Tees.—Factory at Stillington for the British Refrasil Co., Ltd.; Goseley Engineering Co., Ltd., contractors, Lanesfield, Wolverhampton.

Twelve-storey blocks of flats in the Garbutt Street area; borough architect, 28, The Square.

Thorpe. — Secondary modern school (£22,810); chief education officer, Stracey Road, Norwich.

West Ham.—Houses (52), Forest Street; Bridgwater & Shepheard, architects, 42, Bruton Place, London, W.1.

Whickham.—Electrical installations in houses (368); U.D.C. surveyor.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates do not clash with others already arranged

Monday, 30th April

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6.30 p.m. I.E.E. South Midland Education Discussion Circle. "Laboratory Work on Servo-Mechanisms," by E. B. Pearson.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. Discussion on "The Efficient Use of Technical Personnel," opened by Sir George H. Nelson.

Monday, 30th April, to Thursday, 3rd May

LLANDUDNO. — Electrical Association for Women. Annual Conference.

Tuesday, 1st May

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6.30 p.m. Institute of Metal Finishing, Midland Branch. "Works Instrumentation and Automatic Control," by W. F. B. Baker and "Laboratory Instruments and Techniques," by Dr. G. L. J. Bailey.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Centre. Annual general meeting.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurement and Supply Sections. Discussion on "Methods of Fault Detection and Location in Impulse Tests on Transformers," opened by F. S. Edwards. (Joint meeting.)

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Centre. Annual general meeting, followed by "The Control and Instrumentation of a Nuclear Reactor," by A. B. Gillespie.

READING. — University Letters Lecture Theatre, London Road, 6 p.m. A.S.E.E. Oxford, Reading & Districts Branch. Annual district meeting.

Tuesday, 1st, and Wednesday, 2nd May

LONDON. — Church House, Westminster, 10 a.m. Institute of Fuel. Conference on "Domestic Heating in the United Kingdom—Present and Future."

Wednesday, 2nd May

BIRMINGHAM.—James Watt Institute, Great Charles Street, 7 p.m. Junior Institution of Engineers, Midland Section. "Electronic Control—The New Power in Industry," by J. A. Sargrove, followed by film.

BRISTOL.—At the Westinghouse Brake & Signal Co., Ltd., 6.30 p.m. I.E.E. Bristol Graduates' & Students' Section. "Automatic Train Control," by D. J. Norton.

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South-West Scotland Sub-Centre. Annual general meeting, followed by "The Recent Search for and Salvage of the Comet Aircraft near Elba," by Cmdr. C. G. Forsberg, R.N., and G. G. MacNeice.

LEATHERHEAD.—I.E.E. London Graduates' & Students' Section. Visit to E.D.A. Testing House at 2.30 p.m.

LONDON.—Savoy Hotel, W.C.2, 12.30 for 1 p.m. British Electrical & Allied Industries Research Association. Annual luncheon.

MANCHESTER. — Engineers' Club, Albert Square, 7.30 p.m. A.S.E.E. Manchester Branch. Film show.

PRESTON. — N.W.E.B. Demonstration Theatre, Friargate, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. Annual general meeting, followed by informal lecture, "Domestic Circuits and Protection Devices," by H. W. Swann.

49a, Fishergate, 7.30 p.m. A.S.E.E. Preston Branch. "Ventilation in Industry," by R. W. James.

Wednesday, 2nd May, to Friday, 4th May

LONDON.—Savoy Place, W.C.2. I.E.E. Utilisation Section. Convention on "Electrical Equipment of Aircraft."

Thursday, 3rd May

LONDON. — Burlington House, W.1, 4.30 p.m. The Royal Society. "Spin Fluctuation Scattering of Neutrons and the Ferromagnetic State in Iron," by R. D. Lowde and "The Brueckner Theory of Nuclear Structure," by R. J. Eden.

NOTTINGHAM. — E.M.E.B. Demonstration Theatre, Smithy Row, 6 p.m. I.E.S. Nottingham Centre. Annual general meeting, followed by "Brains Trust."

Thursday, 3rd May, to Saturday, 5th May

FELIXSTOWE.—Institute of Welding. Spring meeting.

Friday, 4th May

LIVERPOOL.—9, The Temple, 24, Dale Street, 7.30 p.m. A.S.E.E. Liverpool Branch. "Underfloor Duct System," by W. J. Mann.

STAFFORD. — Technical College, 7 p.m. I.E.E. North Staffordshire Sub-Centre. Annual general meeting, followed by "Germanium and Silicon Power Rectifiers," by T. H. Kinman, G. A. Carrick, R. G. Hibberd and A. J. Blundell.

Saturday, 5th May

HOUNSLOW.—I.E.E. London Graduates' & Students' Section. Visit to London Airport at 9.30 a.m.

LEEDS.—1, Whitehall Road, 2.30 p.m. I.E.E. North Midland Graduates' & Students' Section. Annual general meeting.

LONDON.—I.E.E. Supply Section. Visit to the Houses of Parliament and Greenwich.

Victoria Halls, Bloomsbury Square, W.C.1, 7.30 p.m. I.E.E. London Graduates' & Students' Section. Spring dance.

Sunday, 6th May

LONDON. — A.S.E.E. South-West London Branch. Visit to seaside resort.